

CHILD DEVELOPMENT

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CHILD DEVELOPMENT

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SOCIALIZATION AND THE PARENT - CHILD RELATIONSHIP¹

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To those who deal with parents, it often seems that by the time a theory has been put into actual practice by parents, it is no longer accepted. We often wish that some of the publicized methods had been tested in real life situations before being advocated so strongly. While it is true that practice may lag a generation or two behind theories of child development, there is a section of the culture, an *avant garde*, which is much quicker to learn about and adopt the newer scientific opinions. There are intellectual parents who experiment with such methods as self-demand schedule, raising babies in boxes, release of repressions in play or the use of group decisions in determining family policy within a few years of the time the ideas were first discussed in scientific literature. This intellectual section of our culture thus provides an experimental proving ground which we should exploit as fully as possible to observe impartially the actual consequences of modern scientific theories of child development. It is the purpose of this report to explore some of the consequences of "democracy in the home" upon the personality development of young children.

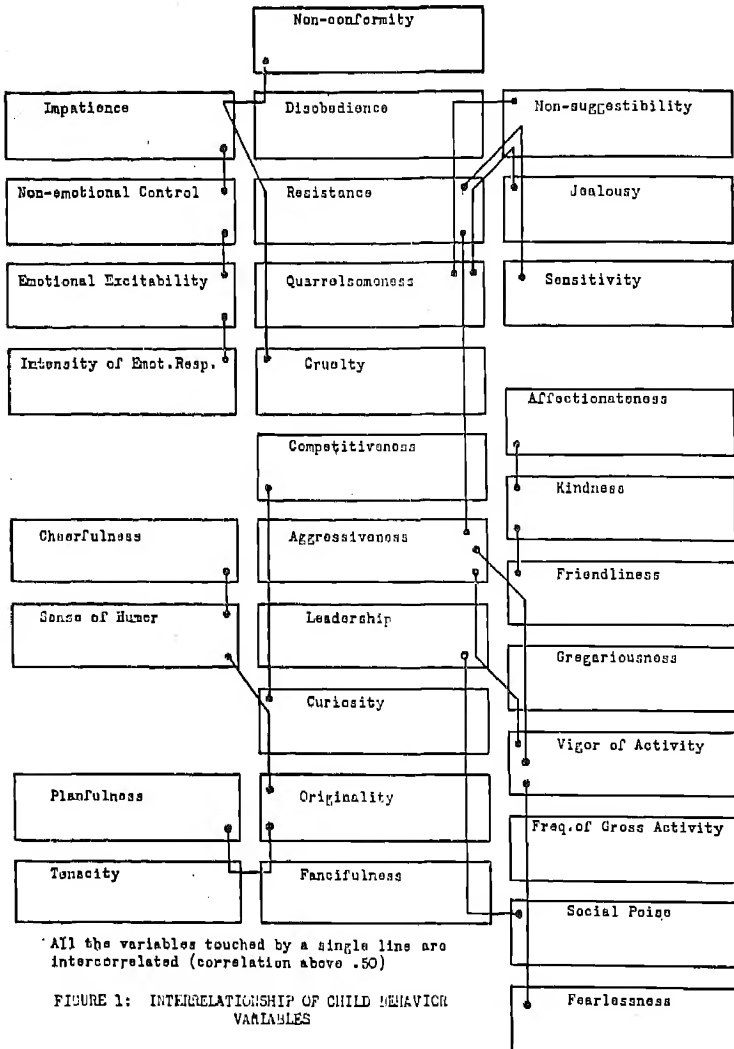
It is well to recognize the limitations of this proving ground as an experimental test of the applicability of various theories. The intellectual culture is certainly no random sample of the culture as a whole. Therefore, the methods of raising children practiced by these people are inevitably colored by the fact that they have a high verbal intelligence; they put a high value on rationality and intellectuality; and they substitute "progressive principles" for the traditional middle-class values without markedly reducing the compulsiveness of their adherence to these principles.

The research which I shall discuss here is based upon the observations of preschool children in the experimental nursery school conducted by the Fels Research Institute. Each child of preschool age attends this nursery school for a month each year during which time he is rated upon a battery of child behavior variables. Concurrently, he is visited in his home every 6 months by an independent investigator who rates the impact of the home environment upon the child in terms of a battery of Parent Behavior Ratings. The sample used in the present study is a group of 67 children, who were observed at the approximate age of 4 years both in the free play group and in the home.

¹Paper presented at a general meeting of the Society for Research in Child Development held in Chicago, Ill., December 27, 1947.

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Figure 1 is a diagram showing the interrelationships among the various child behavior variables. The variables have been so placed upon the sheet that those which are highly correlated are close to each other spatially.



A group of variables whose members are highly intercorrelated with each other form, for the purposes of this report, a syndrome. The members of the various syndromes are indicated in the diagram by a line which extends from the variables at one border of the cluster through all the vari-

ables in the cluster to the variable at the other side. The end points of a cluster are indicated by a heavy dot at the end of the line. It will be seen that many syndromes overlap. In some cases these overlapping clusters will on further examination be combined into a single larger one. In other cases the overlapping variables have very different significance in the two syndromes. For example, aggressiveness and competitiveness take on a particular flavor in the cluster composed of *aggressiveness, competitiveness, leadership* and *curiosity*. In the cluster composed of *aggressiveness, competitiveness, cruelty, quarrelsomeness* and *resistance*, the same two variables have quite a different meaning.

There is evidence for a general factor in this battery of variables, a factor which might be called activeness, or maturity, or good nursery school behavior. The bottom of the diagram tends to represent the socially positive aspects of activity; the top represents the more rebellious and uncontrolled aspects of activity. The right side of the diagram includes variables which describe inter-*personal* relationships; the variables at the left are more impersonal. With this orientation to the battery of child behavior variables, we can proceed to analysis of the consequences of freedom and permissiveness on the one hand, and restrictiveness and pressure on the other.

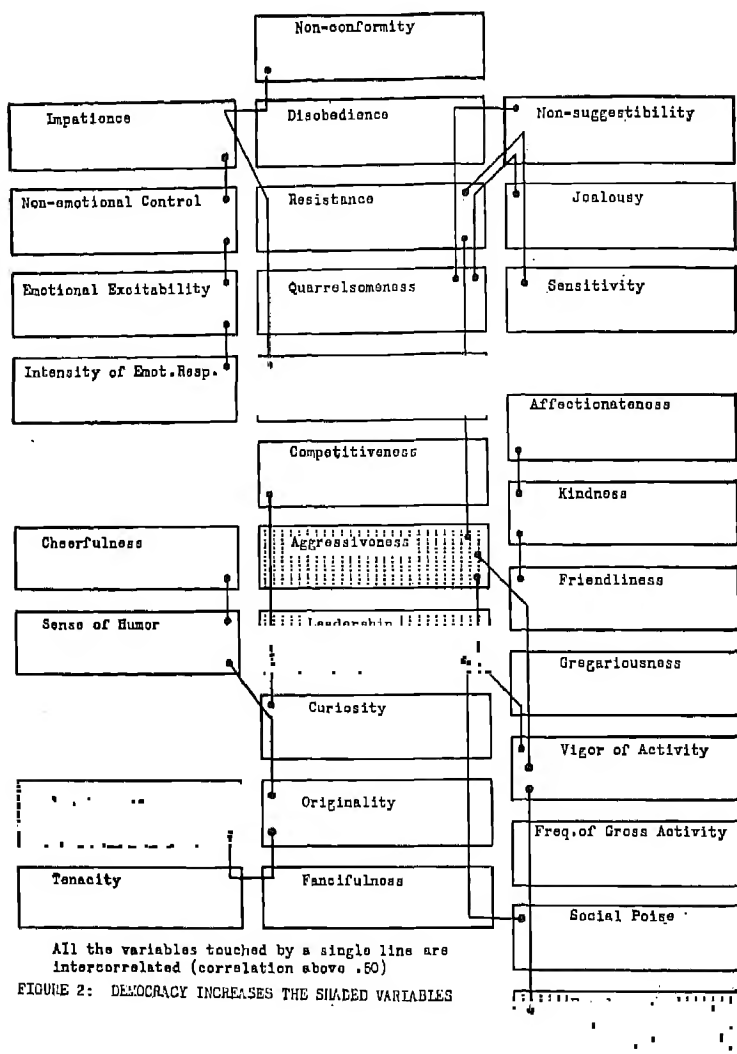
When the variables in the Parent Behavior Rating Scales, used in the appraisal of the home environment, are factor analyzed, two of the factors which are closely related to this problem are democracy and control. Democracy is characterized by a high level of verbal contact between parent and child, appearing as consultation about policy decisions, as explanation of reasons for the family rules, and as verbal explanation in response to the child's curiosity. Accompanying this flow of verbal communication is a lack of arbitrariness about decisions and a general permissiveness plus restraint on emotionality. The second factor, control, is correlated with the first. It emphasizes the existence of restrictions upon behavior which are clearly conveyed to the child, although not necessarily arrived at democratically. Another characteristic of control is the lack of friction over disciplinary decisions. This lack of disagreement might stem from various characteristics, prohibitions on talking back, easy conformity by child, or the determination of the policy by mutual agreement. These two factors are correlated; most democratic homes are not uncontrolled.

If the consequences of these two factors on the child's behavior in nursery school are analyzed together, i.e. if the effects of democracy are studied, keeping control constant, and the effects of control are studied, with democracy kept constant, the following results are obtained:

Democracy tends to have two sorts of effects upon the child's behavior as illustrated in Figure 2. It tends to accentuate by a statistically significant amount the variables which are shaded in the diagram. It seems generally to raise the activity level and to produce an aggressive, fearless, playful child, likely to be a leader in the nursery school situation, but who is also more cruel than the average child of his age. These are the statistically

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significant effects; other variables on which the differences are almost significant are *curiosity*, *non-conformity* and *disobedience*.



Control has not only more significant effects as shown in Figure 3 but they are in the opposite direction. It tends to decrease *quarrelsomeness*, *negativism* and *disobedience* but at the same time to decrease *aggressiveness*, *planfulness*, *tenacity*, and *fearlessness*.

Occurring together, control and lack of democracy produce very marked

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effects in a large number of variables, as shown in Figure 4. The combination produces a quiet, well-behaved, non-resistant child who is at the

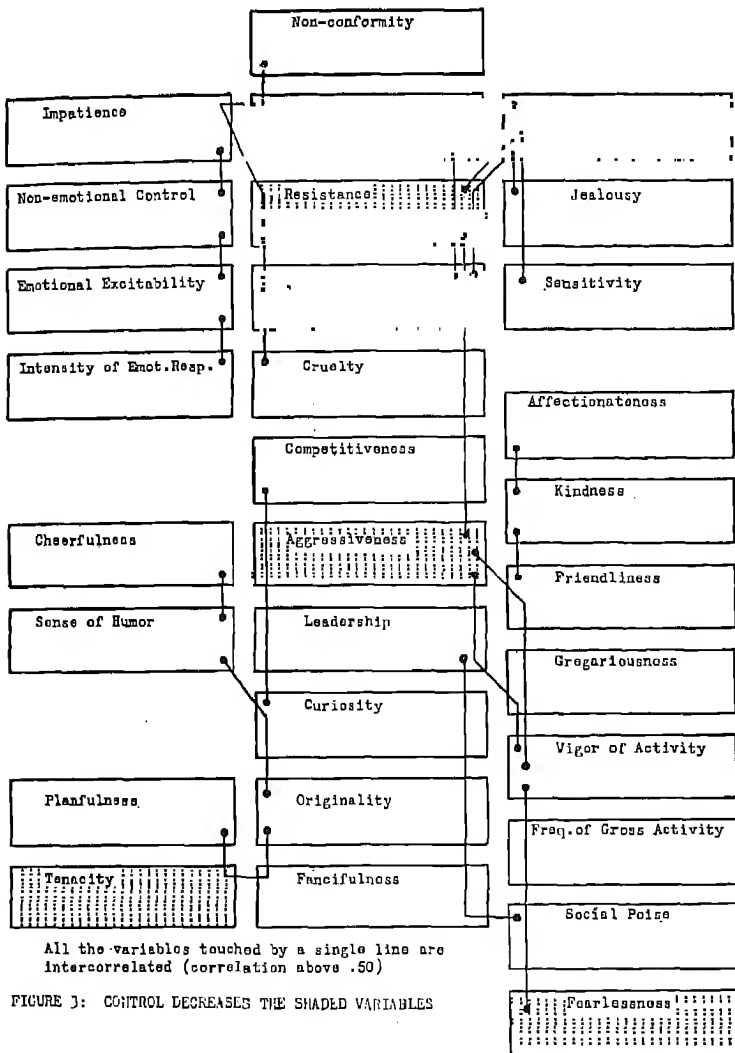


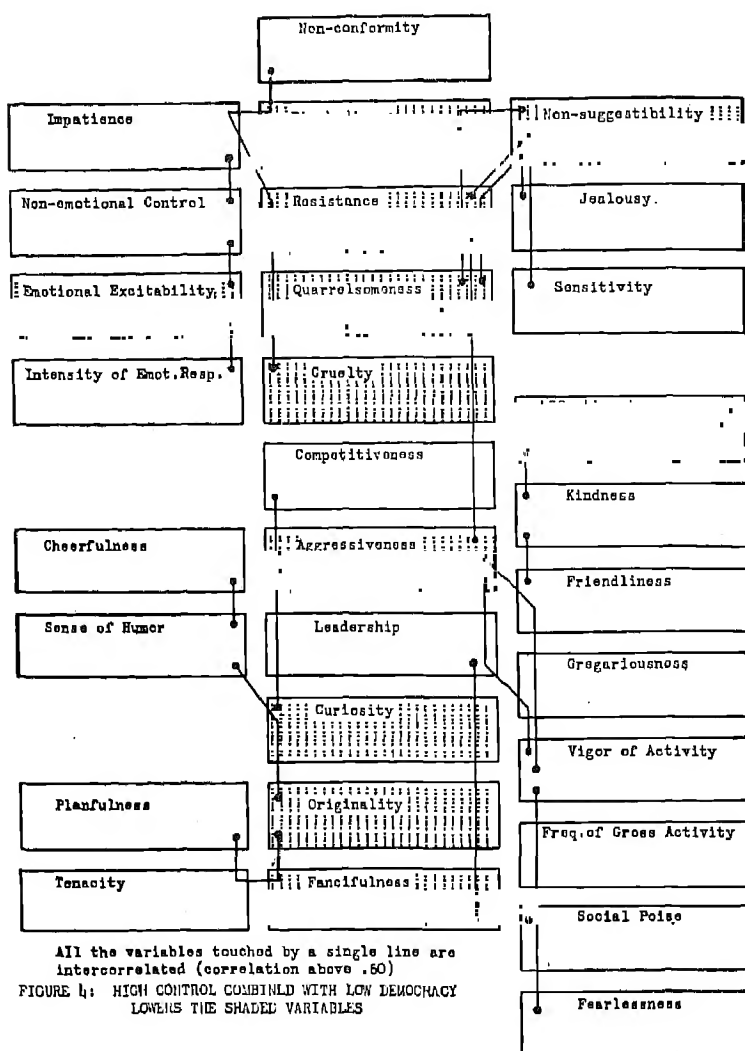
FIGURE 3: CONTROL DECREASES THE SHADED VARIABLES

same time socially unaggressive and restricted in his curiosity, originality and fancifulness. The opposite picture of high democracy and low control produces opposite effects, but very few of the variables are significant.

Thus far, the results generally confirm most of our impressions of the effect of freedom and restrictiveness upon socialization. Socialization by

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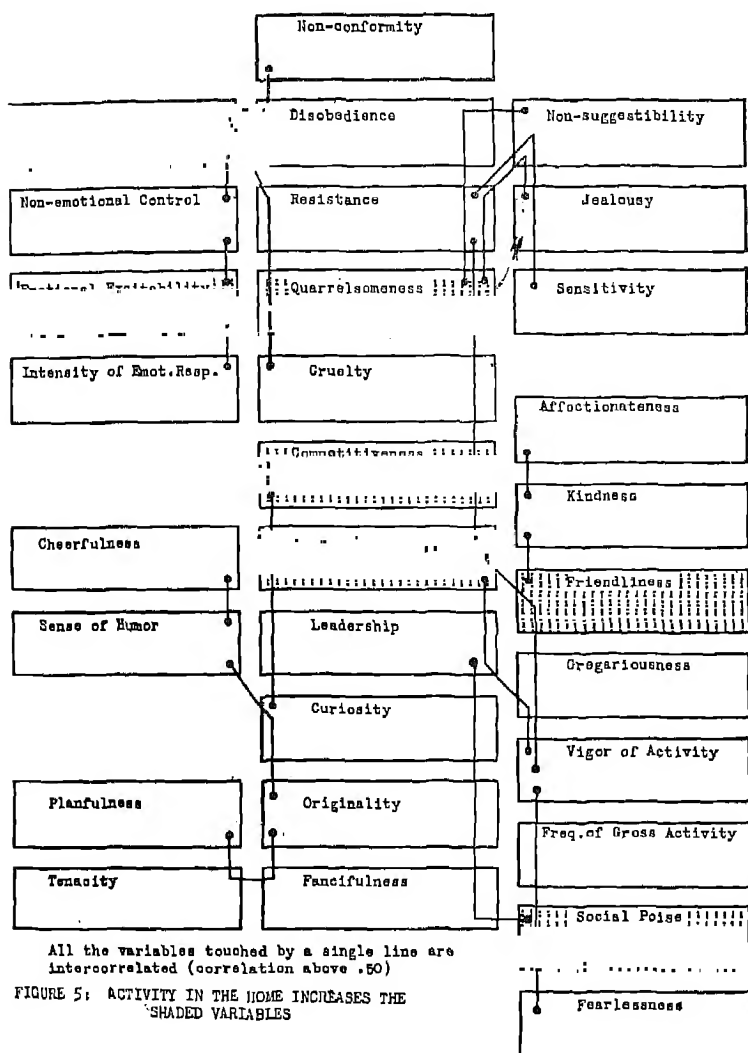
definition demands the development of contradictory aspects of the personality. Conformity to cultural demands is not easily obtained without



robbing the child of that personal integrity which gives him a mind of his own and which supports him in his attempts to satisfy his curiosity and to carry out his ideas and phantasies in his dealing with the real world. Authoritarian control seems to do just that; it obtains conformity but at the expense of personal freedom in areas which are not intended

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to be restricted. Democracy runs the risk of producing too little conformity to cultural demands; but as actually practiced in the Fels families, it

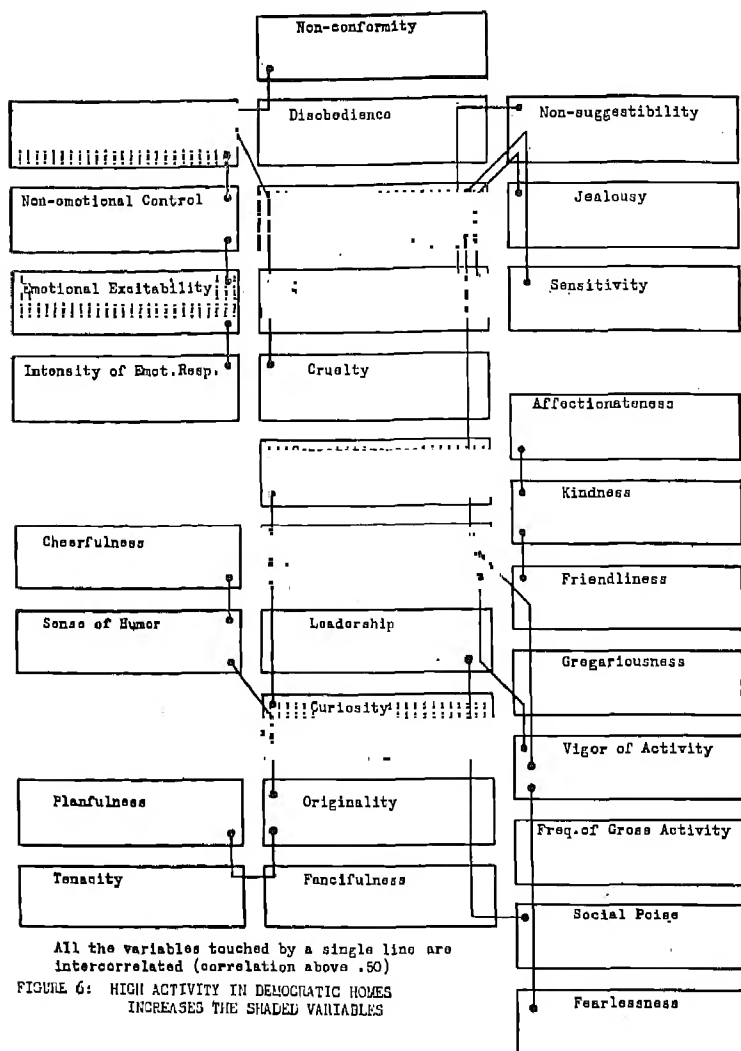


seems to be accompanied by sufficient control to avoid the more serious consequences of this risk.

A third aspect of the home environment, its general activity level, is closely related to these problems of socialization. The active home is characterized by a high level of interaction between the parent and the

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child. In different homes this interaction takes different forms: In some it appears as a well ordered schedule; in others as a continuous flow of



criticism and suggestion; in others as child-centeredness of the home activities; in still others as special training and acceleratory attempts. But if active homes of all varieties are compared with inactive homes as shown in Figure 5, it appears that activity in the home generally raises the child's level of activity in nursery school, and again it raises both the rebellious

non-conforming aspects as well as the socially positive aspects. Activity and democracy have similar effects, but it is possible to differentiate between them. Activity in the home seems to affect the variables describing personal relations rather than curiosity and planfulness which are increased in the democratic home. Activity also differs from democracy in affecting the emotionality variables.

The exact relationship between activity and democracy is revealed by a study of their interaction. There are in this sample about the same number of democratic inactive homes and democratic active ones. These two groups show some rather marked differences. That is, activity is an important factor affecting the child's behavior in democratic homes while in non-democratic homes, activity plays a less important role. Figure 6 shows the effect of activity in democratic homes. The shaded variables are those which are significantly greater in democratic active homes than in democratic inactive homes: *aggressiveness, competitiveness, quarrelsomeness and resistance*, plus *curiosity* on the one side, and on the other *emotional excitability, intensity of emotional response and impatience*. Cruelty too is almost significantly greater.

These findings indicate the advisability of attempting to discriminate among the various kinds of democratic homes. In the inactive democratic homes there is, by comparison with the active homes, more detachment of parent and child; democracy is more casual and less ideological; the level of verbal interchange which characterizes democratic homes is more lethargic and spasmodic; there is more *laissez-faire* and less leadership. In this type of home the effects of democracy are less marked than in a home where there is a high level of interaction. That such a condition would result in a less active approach to the world is reasonable. Hereditary factors probably play a role, but in addition, an unresponsive environment can certainly stultify active expressiveness and aggressiveness toward the world. The child requires not only freedom but response and encouragement if his wishes and his emotions are to be expressed actively, particularly in his relations to people.

✓ These findings suggest that the predominant effect of parent behavior upon the socialization of the preschool child is to raise or lower his willingness and ability to behave actively toward his environment. Freedom and permissiveness in the home by not punishing his active explorations and his aggressive reactions to frustrations, permits the child to become active, outgoing and spontaneous. Freedom alone does not, however, actively encourage the development of spontaneity; a high level of interaction between the parent and child is required to push the child into activity, particularly of the interpersonal variety. The child's expressiveness must be elicited by the parent's spontaneous expression of warmth and emotionality, and the child's attempts to establish emotional contacts with other people must be greeted with warmth and reciprocation, if he is to develop the pattern of habitual expressiveness. ✓

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This activity level of the child seems a prerequisite for socialization, but it is obviously not the whole picture. A high level of activity is accompanied, during the preschool years, by non-conformity and rebelliousness. At this early age, the child responds to stimulation in a generalized and undifferentiated manner, not as yet discriminating between the social and the anti-social forms of activity. The active child, by predisposition or environmental encouragement, is able to express his hostility, but by the age of four he has not, generally speaking, learned how to manage it. The inactive child, does not have the same problem of management of hostility; for him the problem is an intrapersonal one which cannot be adequately investigated by this sort of a statistical analysis of overt behavior. The inactive child's problem, on the overt level, is that of achieving a satisfactory degree of social interaction. The important question from a practical point of view might be stated as follows, "Which of these various patterns of preschool behavior is most likely to lead to a healthy adjustment?" We in child development seem at present to believe that spontaneity, even if it involves rebelliousness, is a sign of good preschool adjustment. Whether that belief is true, true in some cases, or untrue, must be discovered by further research. ✓

PSYCHOSOMATIC PROBLEMS IN CHILDHOOD¹

GEORGE J. MOHR, M.D.

Since this paper is presented as part of a discussion of "Biological Factors in Personality Formation," I shall center my comments about the intimate relationships between common somatic symptoms and disturbances encountered in infancy and childhood and disturbance or deviation of the developing personality of the child. These relationships are more readily observed in small children than in adults because of the more obvious vulnerability of the child in his exposure to a healthy or to a disturbing physical and social environment.

In childhood, the nature of the disturbances that may be designated as "psychosomatic" are dependent upon the biological maturity of the organism (1), and the nature of the nursing and training care to which the child is exposed (2). In the very young infant, the state of physiological maturity and susceptibility to the particular kind of care offered are reflected most commonly in the gastro-intestinal behavior. Appetite disturbances ranging from those that are mild to anorexia that threatens life, reflect errors on the part of the mother in meeting the child's initial need. For the growing infant and child, maternal love and care are essential for the development of security in all life relationships. The feeding situation is, for the child, an experience that initially secures for him comfort and a sense of well-being. When a good nursing or feeding regime and satisfying initial relationship between mother and child are not established, deep discomfort for both follows.

There centers about the gastro-intestinal system and its functioning an essential expression of child's need, mother's readiness or capacity to meet that need, and all the possibilities of fundamental gratification or deepest deprivation for the child. Throughout life, the gastro-intestinal system continues to "mirror the emotions better than any other body system." Menninger (2) remarks that this in part may be because it is partially under voluntary control, and adds, "Next to the skin, the gastro-intestinal system has more contact with the external world than any other part of the personality. It receives more direct demands for adjustment and accommodation, more insults and abuses, and a greater variety of opportunities for gratification than any other set of organs suffers or enjoys."

In early life when there is adequate gratification through establishment of a healthy nursing or feeding regime by a stable mother, the clinical picture of a "normal" infant who thrives physically and gives evidence of comfortable adjustment to his protective environment is usually presented. The implications of such a favorable situation for the healthy personality development of the infant need not be stressed here, and is abundantly

¹Paper presented at a general meeting of the Society for Research in Child Development held in Chicago, Ill., December 27, 1947.

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discussed in the literature of child development (3). On the other hand, the pediatrician encounters many problems that reflect disturbance in the child's initial relation to his world. Anxious mothers who overwhelm the child through overconcern about the details of feeding, or repudiating mothers who, out of guilt, exert undue pressure upon the child that provokes resistance from him, are soon faced with the problem of the child who does not eat well. Depending upon the intensity of the pressure, or of the repudiation as experienced by the child, grave symptoms reflecting the deep disturbance in the child's emotional orientation may develop.

Anorexia nervosa, so called, is one expression of a child's inability to cope with the tensions created by anxiety and hostility that develop in an emotionally depriving family milieu. A history of a child who has reason to feel himself to be unloved and who develops deepest feelings of resentment and hostility towards the presumably depriving or threatening persons in the family setting is consistently found. Children thus deprived are anxious children, and their own hostile feelings increase this anxiety. Published case histories (4) expose in detail the psychological dynamics underlying this unhappy conflictful life situation. The later role of anorexia in the unsuccessful struggle of adolescents with problems involving separation from parents, fear of their own aggressive and sexual impulses and strivings, may have its beginning in the early disturbance here referred to (5). I should like to mention that not only refusal to eat, but addiction to eating can also be an expression of an unsuccessful struggle to cope with ungratified, dependent wish or need, the hostility engendered by the deprivation felt, and, on the other hand, the anxiety provoked by exposure to the opportunities, temptations and responsibilities of adult life.

It may be that the feeding situation is successfully met by both mother and child, but that initial tensions develop as a result of undue pressure in relation to bowel training. If training in cleanliness is attuned to the child's readiness to conform to training stimulus and restriction, by correct timing and lack of undue pressure, the child may readily develop the pattern of behavior desired by the parent. But if pressures are premature, or too great, disturbing results can be achieved. A child may be able to meet pressure through overt defiance and open resistiveness, and becomes the stubborn or destructive child. But many a child may be coerced into an apparent conformity, who nevertheless betrays his discomfort or resistiveness. Constipation in such children is an evidence of such resistiveness; they can hold out against the demands of a parent after all, or perhaps, at times, provoke the interest or concern of the parent. When Hirschsprung's disease is diagnosed, the problem of management may be primarily one dealing with the attitudes of anxiety, resentment and hostility that have been engendered by the concern and pressure relating to bowel functioning. This constitutes a problem in psychotherapeutics; when hostility can more directly be expressed without undue anxiety, the somatic symptom may no

and the overemphasized and a more realistic attitude toward his problem is possible for the child.

Ulcerative colitis in children, as well as in adults, has been demonstrated to be a condition highly dependent upon the emotional relationships between the sufferer and members of his family. There is some evidence too, that this severe form of colitis is a reaction to fairly specific type of conflict situation by individuals with given character traits (6). In two cases studied by Sperling (7), onset of the symptoms followed an experience involving separation from the parent to whom the child was dependently attached, in one instance by the child being entered into kindergarten where he was terrified and from which he had to be withdrawn, in the other following departure of the father for military service. In this latter case, at one point during the course of the illness the father had to be given emergency leave to visit the child because of her critical condition. Characteristic in the family situation is a highly ambivalent or repudiating attitude of the mother toward the child. The child evidences deep hostile attitudes toward the mother with fantasies of her destruction or the destruction of others (e.g. siblings) who threaten his security. Such destructive feelings are necessarily repressed, but come to expression in what proves to be the self-destructive bloody diarrhoea of ulcerative colitis.

Enuresis is another symptom long recognized as an expression of psychological tensions. Like the gastro-intestinal system, the urogenital system can serve for somatic expression of tension related to situations of conflict with which the child cannot effectively cope on a behavioral or social level. For some boys, enuresis seems to center about the problem of clinging to a passive, dependent orientation; they are intimidated boys fearful of their relation to more aggressive strivings (8). Some girls evidence "masculine protest" reaction through this same symptom. In each case the somatic symptom is concomitant with a disturbance in personality growth and in psychosexual development. The symptom can be understood, and coped with, through exposure of the underlying psychological disturbance.

In allergic reactions and related disturbances such as asthma, one is undoubtedly dealing with a biologically determined sensitivity, certainly more predominant in some individuals. The pediatrician is familiar with the child who, in earliest life, shows extreme sensitivity at times even to mother's milk, with skin reactions and eczema. Among these are the children who suffer with asthma. Case studies among adults and children (9) have demonstrated that the fate of the allergic individual is not exclusively dependent upon his capacity to respond in an oversensitive manner to foods or other substances that serve as irritants to mucous membrane or skin. Rather specific emotional states play a role in determining whether a child's asthma attacks will be frequent or infrequent, severe or less severe, or occur at all. As with many other symptoms, an asthma attack can be an expression of a child's basic fear of separation from the parent through

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fear or loss of parental love. Hostile feelings or sexual strivings play a role in threatening the child's security in a dependent relationship with the mother. With or without a residue or allergic sensitivity, the diminution of physical symptoms may be dependent upon alleviation of the emotional stress.

Tensions that cannot be mastered by the child and expressed in integrated action or adjustment, may be expressed through the muscular system as well as through the activity of the several organ systems. Speech disturbances, tics, and perhaps some convulsive disorders of childhood would be representative of such psychosomatic conditions.

Study of children in psychotherapy, who manifest tics, has demonstrated rather characteristic disturbances in their familial relationships and, again, with fairly constant reaction of the children to this disturbance. Children who suffer with tic are likely to be externally reserved in manner and polite. An underlying deep resentment or hostility toward adults considered to be restrictive or intimidating is found (10). Gerard (11) regards the tic as representing an incomplete act of aggression. Levy (12) in this connection comments on the development of tic-like movements in animals restricted in movement. Certainly these children are under restriction in the face of deep feelings of resentment, and the discharge of the accompanying tension through motor movement results. The strong defenses some of these children develop against their aggressive feelings is reflected in the relatively rigid personalities they present to the outer world.

While I have thus far discussed psychosomatic problems of childhood as somatic expressions of tensions the child has not been able to cope with through behavior or through other process of integration, it is of equal importance, at least for the clinician, to study the influence of somatic disturbance on personality development. From this point of view, all illnesses of childhood are "psychosomatic" problems, inasmuch as any disturbance is likely to affect the developing personality of the child. It is obvious that if a growing boy suffering with rheumatic fever develops a cardiac involvement that imposes a long period of convalescence, even if the cardiac condition clears up entirely, there are likely to be psychological repercussions. If the illness actually imposes a continuing restriction of activity, which may also be overemphasized by anxious parents, reactions on the nature of self-depreciation, anxiety in competitive relations with other boys, withdrawal from more active situations calling for a boy's more aggressive potentialities tend to occur.

Children who suffer with diabetes are particularly exposed to a situation that has disturbing potentialities relating to character and personality development. A young diabetic patient, a boy of eight, was seen because of obsessional ideas and phobic reactions. For some time he reacted with greatest anxiety to the mother's steps in weighing and measuring foods, his idea being that if she made a mistake about this, it would be the equivalent of poisoning him through having too much or improper food. At

all times he remained most conforming and meticulous in carrying out dietary regulations, which were not stringent. He learned to give himself the necessary injections of insulin. He soon gave up the "poisoning" idea, but developed other disturbing ideas. An old lady known to the neighborhood died. He had the idea that perhaps she died because he had accidentally bumped against her in passing some time previously. A playmate was hurt in play; he thought perhaps it was his fault, perhaps he had bumped into him.

In manner and speech, this boy was excessively well controlled and quiet, rarely smiled. He was an exceptionally responsible little fellow, well liked by his friends with whom he played freely. His diabetes was not severe, and his general state of health good. It was evident, however, that the diabetic condition, and the management instituted, was reacted to in an overly meticulous, compulsive manner. The resentment and hostility he felt at the restriction imposed upon him could be expressed only in a manner directed against himself; that is, in fantasies of hostility directed toward others but with much feeling of guilt. The effect is like that of an over-trained child with the inhibitions and restrictions exhibited by such a child.

Not all diabetic children react in this manner. Daniels (13) cites the situation of an adolescent boy, who reacted with embarrassment at leaving group games, at not being able to have a snack with the boys now and then. The apprehensive family tended to put considerable pressure upon him, and even utilized the diabetes as an excuse to impose restrictions that had nothing to do with diabetes. Unlike the little phobic boy, this boy revolted against all the restrictions attempted by the parents. As Bruch (14) points out, authoritative doctors or parents may succeed in having the children accept restrictions with considerable docility, which may be "good for the disease, but not for the child."

In this brief survey of some psychosomatic problems encountered in childhood, it is apparent that a wide range of physical disturbances may be understood as reactions reflecting disturbances in the relationship between the child and the important persons of his familial environment. We consistently find ourselves dealing with the emotional problems of the dependent need and attachment of the child toward parent, the effect of protective or of hostile attitudes of parent toward the child, the child's reaction to his own hostile or destruction impulses and to threat of separation from the parent or parental love. As indicated at the outset, the nature and intensity of these childhood reactions are dependent upon the biological maturity of the organism at the time undue stresses are imposed upon the child, and the nature and intensity of these stresses. A more comprehensive approach than that which I have attempted would include consideration of the role of constitutional determinants in the selection of the given organ system utilized as the vehicle for expression of the tensions with which the child struggles. However, I consider this out-

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side the scope of the present paper. I would lay greatest stress upon an understanding of the intimate and precise nature of the child's interpretation of the familial environment, and of the precise meaning of the parental role in determination of the pathological picture presented. It is obvious that the fundamental therapeutic approach to the problems of childhood here presented would be the preventive approach. A rational mental hygiene of childhood, with appropriate nursing, training and educational program really attuned to the child's progressively evolving needs, would be expected to insure healthy emotional growth and personality development, free of the pathological complications here discussed.

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THE SOCIALIZATION OF THE DELINQUENT¹

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The term "juvenile delinquent" has long vexed research workers. It designates a person whose behavior has violated certain codes, but it does not include *all* such persons. The term "unofficial delinquent" has helped define delinquency as behavior rather than designating "caught" persons. Neither is it safe to assume that the caught persons represent the more serious extreme of a behavior continuum; the application of codes to juveniles in the legal process is known to vary among different courts. Consequently, an analysis of the socialization of the delinquent must recognize at the outset that the definition of delinquent generally used is at best a crude, albeit a practical one.

Socialization is the learning process whereby the child comes to fit himself acceptably into the manners and institutions of the family, the neighborhood, community, and society in which he finds himself. Socialization is the learning of patterns of behavior which are conventional in the society. Socialization includes the curbing and redirection of immediate and direct gratification of basic needs; it also involves the acquisition of the so-called "derived needs"—status feeling, gregariousness, etc., as well as many specific attitudes and feelings.

SOCIALIZATION OF THE CHILD

Child psychologists have described rather well the broader aspects of the socialization of the young child, although they have not always recognized the ethnocentric nature of their description. Ethnologists have supplied a corrective in their descriptions of child socialization in other societies. More recently, Warner, Davis, Havighurst and others have shown that the process varies appreciably in many specific ways in different subdivisions of our own society. Presumably, these differences have something to do with the adult personality that eventuates from the socialization process. Until more complete studies are available however, we must be content with the generalization that personality variation within sub-groups of American society is probably as great or greater than the variation between such sub-groups.

When one addresses himself to the topic of the socialization of the delinquent, he is concerned principally with the later childhood and adolescent years. Delinquency is strikingly a phenomenon of adolescence. Young children frequently are designated as "problem children" or "be-

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havior problems." Some of the problems noted in younger children disappear as the child grows older and interacts with his environment in new ways and at new levels. A number of other such problems may be corrected by therapists or clinicians. Some persist, becoming more organized and overt, and eventuate as delinquencies.

Not only is adolescence the period when "behavior problems" mature into full-fledged delinquencies; it is also the period when the individual makes his transition to adult male or female status. True, as a child, he is a member of a family, a social class, a community. He is subjected to differential treatment because of color, class, or sex, and has developed a number of attitudes toward himself and toward others. But puberty brings new attitudes of the individual toward his physical self, and projects him onto the larger society in a masculine or feminine role quite different from the sex status he carried as a child. These transitions require certain readjustments in parental authority; generally these readjustments are affected readily enough but not always so. Although developing physically as an adult, the individual is frequently subjected to a number of parental restrictions on conduct, to which he does not always accede easily. Then, the adult members of society remark on the various forms of adolescent protest, revolt, and "growing pains."

It should also be noted that the adolescent strives for adult status in a society not so ready as many primitive groups to accord him that status. Moreover, he has this experience in a society which itself is rapidly changing. The adult in the family, confused by the inappropriateness of many of his own habits and beliefs in a changing world, may not be tolerant of changing attitudes and standards in his own young. Or the parent, his own family habits disrupted by the changes in the social order, may neglect or ignore the adolescent—a situation equally confusing to the adolescent, who often seeks moorings in the midst of his "revolt."

The child or adolescent is not merely "socialized." He is an active participant in the process. He has growing concepts of himself and his goals, which help shape the personality he is becoming. He resists certain influences, yields willingly enough to others, accordingly as those influences may run counter to, or are congruent with the flow of his own developmental direction. The person is never merely putty in the fingers of circumstance; he is substance with some resilience and a character of its own. The increased emphasis on this characteristic of the person is seen in the current attention which pediatricians give to "self-selection" and "wisdom of the body," which clinicians give to the integrity of the individual and the striving nature of behavior, and which counsellors give to the "client-centered" approach.

THE COMMUNITY

Socialization is a total process and for convenience one may discuss the delinquent as he relates to each of several of the major institutions of im-

portance in the adolescent's life and experience. One of the most completely investigated aspects of delinquency in the community environment is the so-called "blighted" or delinquency area in the large city. As a social phenomenon this has been very completely described by many sociologists, and as it relates particularly to the delinquent, Clifford Shaw's analyses are classics of their kind (25, 26).

It must be noted, however, that Shaw's definition of the delinquent is the social-legal one. His maps plot the cases brought into court. In a certain large Middle-Western city not long ago, the depredations of Hallowe'en led one sociologist to plot two items which may be considered indices of delinquent behavior—the amount of breakage of street lights, by census tracts, and the replacement of window glass, by schools, for a year. He found a high correlation between the two, but the heaviest areas of replacement coincided with some of the better residential areas. In fact, the zones on a plot-map were almost a direct reversal of Shaw's classic pattern—the breakage was higher consecutively in concentric zones from the city center outwards.

In relation to the court appearance of a number of youth of the city's "better families" in connection with these Hallowe'en depredations, one judge is reported to have remarked that he was seldom privileged to witness such an array of high-priced legal talent. Authorities were openly critical of the parents' attitudes in denying misdemeanors on the part of their children. (Those whose adolescent sons and daughters were actually apprehended in acts of vandalism had a little harder time explaining away, of course.) Such observations show that delinquents may be more difficult to locate in some areas of a city than in others, even though the delinquent behavior exists.

At one time the delinquency area was commonly the home of immigrants, and the culture conflict theory of delinquency was plausible. The blighted area is still the home of transients and lower class persons, and it is undoubtedly true that in the lower social classes personal violence and property offenses are taken much more casually than in middle or upper class levels. However, it cannot be successfully argued that delinquent behavior invariably consists of acts acceptable at one social level (where they originate), but unacceptable at others, particularly the upper-middle class groups who represent the conscience of society.

It can be argued that there are actions which are pretty generally disapproved throughout most levels. Even if each social class had a code peculiar to itself, there would be disapprovals of those individuals within the group who did not live according to the code, hence there would be delinquents recognized by the group.

On the other hand, the psychiatric or psychological definition of delinquency, as behavior of a child seeking to adapt himself and his needs to demands placed upon him, tends to stress personality peculiarities or short-comings of the individual who is not adapting.

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This seeming variance between two theories of delinquency may be over-drawn; probably both are correct. Kvaraceus brings the two theories together when he says "it is highly probable that delinquent aggression has its roots in the conflicts and frustrations that take place in the lower-lower, upper-lower, lower-middle and to some extent the upper-middle classes" (16). There are undoubtedly children whose behavior does not appear very serious to themselves or to their families, because they have never known otherwise. There are also children whose delinquencies portray patterns of aggression developing out of personality problems and frustrations. They are aware of wrong-doing and social disapproval, but seem to be helpless in the grip of emotional forces compelling them into misbehavior.

LEISURE TIME

The community affects socialization in another way. The facilities of a community and its neighborhood traditions influence a child's play, and play life is important in the socialization process. In the first place, play permits the child to use and perfect new activities made possible by the coordinated growth of maturation and learning. The sequences of motor activities in the development of the young child come to mind immediately, and the satisfaction young children seem to get out of the repeated performance of a new activity has been frequently remarked.

Play activities also permit certain substitute satisfactions. Thus, certain aggressive themes in children's playing "house" or "school" may reflect their reactions to the adult aggressions they have experienced in such situations. It is this function of child play which has been utilized so successfully in doll play studies with children.

Play also permits a child symbolically to enter into certain roles which he is learning to accept or which, in time, he will find necessary to develop. Thus, the so-called imitation of adult activities frequently carried out by children, or the emphasis on certain kinds of bold, daring masculine activities by boys, and the developing of home making themes by girls permit a kind of role-taking which reinforce attitudes, even if they do not in our society serve to initiate the individual into such adult activities.

Studies of play interests of delinquent children have almost all been surface or descriptive in nature. We have studied the participation of delinquent children in all sorts of games and activities, but we have not studied these activities as dynamic—i.e., in terms of the functions of the play for the purposes and needs of the individual. Such studies are needed.

The writer has published material showing appreciable differences in the play activities reported by delinquent boys and non-delinquent boys coming from delinquency areas in cities (9, 10). On the basis of such differences, it has been found possible to differentiate rather clearly between groups of legally adjudicated delinquents and non-delinquents. A scoring key derived initially on Minnesota youth has given similar results with

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other delinquent and non-delinquent groups from Utah, Minnesota, Indiana, and Washington, D.C.

Activities consistently differentiating delinquents and non-delinquents the most reflect, first, greater freedom from parental supervision and restraint on the part of the delinquents, and second, identification of delinquents with an independent, free, "tough" pattern of activity. Such items as being out late at night, going to fairs and carnivals, having dates, playing along railroad tracks, frequently going to the movies, especially gangster and Western films, going to poolrooms, going around with older or "hard-boiled" fellows that have money, hitch-hiking, playing poker, pool, "Rummy" for money, bumming around, and similar activities suggest both greater freedom of movements and a particular kind of identification among the delinquents.

Non-differentiating items include constructive, educational interests such as membership in school clubs, experimenting with electrical apparatus or chemicals, making collections, doing hobby or craft work. Sports, such as volley-ball, wrestling, track, football, baseball, and gym activities, are as popular with delinquents as non-delinquents.

The Chicago Recreation Survey (24) kept records of the attendance of all children in playgrounds, play centers, and neighborhood houses in certain districts for one year. The attendance records of known delinquents, unofficial delinquents, and non-delinquents were then compared. In general, it was found that delinquents were, if anything, a little more likely than non-delinquents to avail themselves of constructive play opportunities, and in those situations participated in much the same type of activity as non-delinquents. Such a finding is an interesting behavioral confirmation of the questionnaire findings of the present writer. The Chicago study, however, discovered a slight tendency for the delinquent to seek out more quiet pursuits such as reading or table games rather than organized group activities. The group reinforcements of these children were probably being found elsewhere than in organized centers.

The play activities of delinquents, then, permit the individual to gratify certain personal aims for thrills and adventure and to dramatize certain roles. The delinquent's play activities reflect a greater laxness of parental supervision, a greater freedom to roam widely and to identify with more "mature" kinds of activities common in the delinquency area. This argument suggests that delinquents have a wider community experience than do non-delinquents, and is in agreement with Atwood's findings (1) that juvenile delinquents show a greater amount of social contact and participation.

HOME AND FAMILY ADJUSTMENT

The factor of poor family adjustment is one of the most consistent findings of research on the delinquent child. At least two studies have found the home adjustment scale of the Bell Adjustment Inventory to differen-

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tiate significantly between delinquents and non-delinquents, whereas health and social adjustment scales made no such distinction. The emotional adjustment scale separated the delinquents and controls significantly in the Bartlett and Harris study (3), but not in the Merrill study (18). Krause (15), however, found no difference in the home adjustment scale of a modified form of the Bell; he did find a poorer school and emotional adjustment, however. The well-known Healy and Bronner study (13) of delinquents and their non-delinquent sibs also revealed the poorer family adjustments of the delinquent children. Data in the Merrill study (18) suggests that delinquents are considerably less ego-involved in the home situation.

Bach and Bremer (2) in a comparative study with smaller numbers of cases have suggested that delinquent boys showed more indifference to their fathers than normally adjusted children, who gave significantly greater evidence of aggression received from fathers and of hostility felt toward father's aggression, as well as evidence of more affection received from father. They suggest further that the delinquent has a weaker disapproval anxiety as contrasted with the normally adjusted. That there is actually less parent-child interaction in the case of delinquents agrees with the anecdote reported earlier, wherein the well-to-do parents of children brought into court were judged to be indifferent toward their children's behavior and quite unconcerned over the desirability or necessity of any supervision of adolescents' hours or activities.

Very little work has been done on attitudes of delinquent boys toward parents, but it appears sound to conclude that delinquents typically are not as closely knit into family experiences. Consequently, their socialization experience in the primary group is different from that of non-delinquents.

SCHOOL ADJUSTMENT

The school adjustment of delinquents has been uniformly reported as poor. One of the early single signs of delinquency is chronic truanting from school. In various groups studied, the delinquent is typically three years retarded educationally, and likely to test even below his placement level in achievement tests (17). Even when differences in mental level are allowed for, the delinquent has frequently failed to achieve. That schools should adapt their curricula to slow learning, or uninterested children is a recurring theme in the various pleas that are made for delinquency prevention (20). The delinquent thus does not do too well in a major experience in the lives of most adolescents—work and social life under auspices of school teachers. In this area, then, the delinquent is not sharing equitably or effectively in the socialization process of youth, and, as has so frequently been shown, this being out of step may date back into the elementary grades and be a persistent and cumulative phenomenon up into the junior high and high school.

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THE PEER GROUP

Perhaps the most significant aspect of the socialization of the adolescent is the peer group. Zachry (31) and Tryon (29) in their studies of adolescents have made this factor central to the adjustment of the adolescent. Kingsley Davis (6) argues that the inconsistent and contradictory attitudes of adults combine to drive the adolescent into the company of his peers. Sherif and Cantril (27) hold that the indifference or neglect of parents of delinquent type children force those children to discover status in gang activities of contemporaries to an even greater extent than the typical adolescent.

It is the opinion of Thrasher (28), whose work on gangs is well known, that the juvenile gang arises out of the spontaneous play group. We have seen that delinquents exhibit a characteristic pattern of play interests as contrasted with non-delinquents. The play group which develops into the gang is important in juvenile delinquency, for delinquencies are rarely "solitary" activities. In one survey 82 per cent of all delinquents studied committed their offenses as members of groups (26, p. 167). Of stealing incidents alone, 89 per cent of all offenders came to court as group or gang members.

It is interesting to note that Hart's (11) factor analysis of 25 traits in 300 delinquent boys yielded six factors, at least four of which have a distinct group reference: temper-assault, general compensatory behavior, aggressiveness, leadership, street-gang activity, and group stealing.

A review of the extensive sociological work on gangs brings one to the view that group activity of the delinquent is a very natural and normal effort of youth to seek approval, status and purpose. In the delinquency area, with its fewer inhibitions and supervision, group behavior is likely to take undesirable forms (28). Thus, as Whyte says, gang activity may be evidence of the individual's seeking and attaining a measure of meaningful social and personal life rather than evidence of disorganization or disintegration (30). Gangs generally are very well organized, both as to purposes and modes of action. They exact a distinct loyalty from the members, who exhibit a marked "we" feeling. Group slogans and norms arise. In the gang the individual finds a meaningful conception of himself. As the members grow out of adolescence, marry, and find new channels for status and recognition, many drop their gang activities. Relatively few persist in organized crime (28). Such observations fit closely into the Gluecks' (8) theory of maturation applied to juvenile crime. They find that the passage of time seems to be the principal factor in causing delinquents to reform.

Some work has been done on the self-attitudes of delinquents. Daniel (5) found Negro delinquents more critical of the "average boy" and more frequently expressing feelings of superiority to the "average boy" than the non-delinquent. Reusser (22) concluded that delinquents feel themselves

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more different from the "average boy" than do unselected boys. He considered the delinquents more out of touch with the attitudes and ideas typically held by unselected boys and somewhat less able than unselected boys to estimate the feelings of others. Rubenstein (23), comparing well-adjusted and maladjusted cases in an institution for dependent children, has stated that the well-adjusted more often report themselves as superior to the "average" child, and that the maladjusted report feeling inferior more frequently and are generally more self-critical concerning various matters of thought and behavior. Well-adjusted children criticize other children for anti-social acts and thoughts, while poorly adjusted children criticize others on relatively innocuous behavior. Such findings indicate the need for study by a variety of techniques, projective as well as questionnaire, to rationalize this matter of self-appraisal and the self-image in relation to socialization.

THE MORAL CODE

Another experience in socialization is the adjustment to the larger social code, or the code of the prevailing social group. Tests of moral knowledge generally show that such knowledge is not too closely correlated with ratings of character or conduct. One study, using a standardized test of the right thing to do in certain situations, found that delinquents are quite as versed in the verbal analysis of moral situations as are non-delinquents (3). This same study showed delinquents to be as informed in Biblical names, places, and concepts as non-delinquents, which finding agrees in general with the low correlations reported by Hartshorne and May (12) between religious practice (such as Sunday School attendance) and ratings of character, a conclusion also supported by Hightower (14). The various studies of gang behavior attest that general social norms may be fully understood without being accepted by the individual. These studies clearly show how juvenile groups develop their own standards which are accepted by the members and do become influential.

The necessity of differentiating between formal and functioning standards verbalized by the person is attested by a considerable body of data. Middleton and Wright (19) show that delinquent girls have more favorable attitudes than non-delinquents on the Thurstone scales toward the law, God and the Church. Bishop (4) states that scales of the Thurstone type developed for a series of "good" and "bad" social habits fail to reveal differences between delinquents and non-delinquents.

On the other hand, Bartlett and Harris (3) found that an attitudes test toward a series of social acts did differentiate significantly between delinquent and non-delinquent boys. The writer is of the opinion that attitude studies of this type, where items are related not only to each other but also to an hypothetical absolute standard of moral judgment, and scales which compare a person's own attitude to what he thinks others believe, may

yield valuable information on this problem of the interiorization of standards.

Another area which appears to be significant and in which little work has been done is the attitudes of delinquents toward money and work. Durea's studies (7) have suggested that the typical delinquent admires prestige, especially that conferred by good looks, dress, money, physique and display. He admires occupations and people who are in the "conspicuous consumption" class or whose work is thrilling, adventurous, or prestige-gaining, such as professional athletes, movie stars, circus performers. Here again the inference is strong, that delinquents get tied up with a series of standards which are superficial and more likely to appeal to the immature.

Sherif and Cantril (27), in discussing the ego development of the adolescent, make delinquency principally a matter of conflict of parent and adolescent norms. Delinquency is held to be an expression of adolescent maladjustment to primary group standards, or failure to interiorize those standards, with resultant identification with peer groups.

It is necessary, however, to recognize that most, if not all adolescents, experience some measure of conflict with parents or with prevailing social norms, while only a few are classified as delinquent. Why the minority only are censured for their deviations from norms, probably must be explained partially in terms of the relative number of times and the flagrancy with which norms are violated, and partially in terms of the degree of finesse in covering up deviations or placating offended elders. Partially, too, it may be a matter of family prestige.

Porterfield (21) found that a group of college students admitted to a series of juvenile delinquencies quite as serious as those noted in a sample of court offenders. The offenses had apparently not been as frequent in the college group, however. Differences in socio-economic status and family organization were held to explain in part the relative impunity with which students could commit delinquencies and also to explain the differential after-careers of the two groups.

After all, social norms do change and the change may well be brought about by the modifications wrought in norms as they are interiorized by successive generations of adolescents undergoing the socialization process.

SUMMARY

A study of the delinquent, then, introduces no new factors in the socialization process. Contrary to popular thinking, the delinquent is not "socially maladjusted." He is frequently quite well socialized, but in terms of standards and group applications too deviant to be acceptable to the larger social body. He is an adolescent who frequently comes from an environment in physical transition, where family and neighborhood social controls are likely to be casual or nonexistent. Generally, he is not closely knit into a

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family structure which supplies ego reenforcement and aids the process of interiorization of adult norms. He seeks status and ego development in peer groups where adult influence and restriction will be at a minimum. Quite uniformly the delinquent has failed to participate effectively in the school environment for some years prior to his delinquency; hence, he is out of touch with experiences shared in by most of his age-mates. Researches on the play interests of delinquents confirm the judgments of many observers, that the values of the delinquent are frequently superficial and "attention-getting." His activities indicate an early identification with ways of behavior usually forbidden children but generally tolerated in the adult—smoking, drinking, being out late, gambling, and the like. There is ample evidence that the delinquent is quite conversant with the wide social code, yet there are suggestions that on an absolute basis as well as on a relative basis his values are scaled somewhat differently than are similar values in the experience of non-delinquents. Much more research is needed, not only on the values that are accepted, but also on the process by which they become "interiorized."

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THE MEASUREMENT OF THE MENTALITY OF INFANTS

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The measurement of the intelligence of infants presents all the problems of measurement in other fields, as well as a few special problems of its own. Two of the more serious of the latter type are: 1) can the intelligence of infants be measured? and 2) granted that it can be, how predictive will such measures be of later ability?

To the first question the best answer that can be given is that there is disagreement among authorities in the field. But the fact that several attempts have been and are being made at least indicates a hope that such measures are possible.

To the second question—the later predictableness of test scores—two rather categorical but diametrically opposed answers have been given. Nancy Bayley (1) tested each of 48 children eight times between one month and their ninth birthday. Correlations between early consecutive tests were as high as .57 but between early tests and those at 18 months they approached zero and with later tests they reached a negative correlation as high as $-.21$.

In interpreting Bayley's results the following facts should be kept in mind.

1—Her tests like most others of that time contained many tests of physical and maturational processes.

2—The reliability of her early tests was low, .51-.74. For later tests it was .85-.95. Validity was not measured.

3—Her test group was very atypical. The mean I.Q. at 9 years was 134.

It is hard to understand why her correlations would become negative between early and later tests. It seems paradoxical at least that a high early score would indicate low later ability and vice versa. Could it be that her tests like the Babinski reflex measure characteristics which tend to disappear in the normal child?

In contrast Gesell believes that early tests give accurate information about later development. His position is well summarized in "Biographies of Child Development." He says "The behavior biographies which we have just reviewed give clear evidence of a high degree of latent predictability in the early sector of life. In the whole series of 30 diversified specimens there is no instance in which the course of trend of mental growth has proven whimsical or erratic." Sixty cases studied later generally support the same view, that is, early test scores predict later levels of attainment.

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For the last six years the author with the assistance of several collaborators has been constructing a new infant intelligence test.¹ The general aim has been to select predictive items which measure adaptation to physical and social environment. First, all previous tests were collected and analyzed. Roughly one-third of the preliminary test was chosen from these sources—and largely from Gesell. Nearly as many more were adapted from such sources but with some change in method of giving or scoring or both. The remainder were new tests devised largely by comparing the behavior of younger and older babies in order to note signs of development.

A preliminary battery of test items was constructed and given to a group of infants at the Evanston Cradle (2). An analysis of the results was made on the basis of the objectivity in giving and scoring of the tests and evidence of age-grade progress on the tests. On the basis of these results a new test was devised. It was divided into three parts. There were 15 items in what was called a 4-week test, 19 items in an 8-week test, and 19 in a 12-week test. Several of the items of the 4-week test were repeated in the later lists. As a result of further giving and analysis, the tests were again revised. Several items were dropped and others were added. This produced a test consisting of 19 items in each of the three sections. In practice all these parts were generally given to each child and tentative norms were developed for each age on each part as well as on the whole test.

This battery of tests was administered to between 400 and 500 infants mostly from the Cradle, but others were included from the Florence Crittenden Home in Peoria, St. Vincent's Orphanage in Chicago, and several babies in private homes, mostly from the faculty and married students at Northwestern. Scores for many tests had to be discarded because the tests were incomplete or improperly given or recorded. A person without experience in giving tests to babies hardly realizes the difficulties involved. Much has been written about rapport in giving tests to adults. No adequate discussion of this problem with infants has been discovered. It is even more important and difficult to attain rapport with infants than with adults. There is no use trying to test a baby who is sleepy or crying. Tests are generally given between 20 minutes to 2 hours after feeding if the child is awake, dry and not crying. If the child begins to cry, the test is discontinued at least until the crying ceases.

Upon the basis of tests for 276 babies whose records were complete and usable a final revision called the Northwestern Infant Intelligence Test has been completed. The present test consists of 40 items chosen on the basis of four criteria: 1) Tests with definite directions for giving and scoring; 2) Tests that require relatively simple equipment; 3) Tests which measure adaptation to the environment rather than physical growth or maturation; 4) Tests that show definite age-grade progress. That is, only those test items

¹Special credit should be given Dr. Anna Shotwell, who helped assemble the first form of the test, and Mrs. Dee Burks, who has helped with later revisions of the test.

were retained that were passed by increasing proportions of babies from week to week.

The resulting test has a reliability for odd vs. even items for each week from 4 to 11 varying between .79 and .94 with an over-all reliability of .84 when corrected by the Spearman-Brown formula.

Norms in terms of the number of items passed have been established largely on babies at the Evanston Cradle. Norms for each age from 4 to 12 weeks can be derived by the use of the following formula: $\text{norm} = 14 + 1\frac{1}{2}(\text{age in weeks})$. For example, the norm for ten weeks is $14 + 1\frac{1}{2}(10) = 29$. The I.Q. can be determined by giving three points credit for each point of deviation from the norm for any age. That is, a 10-weeks-old baby with a score of 31 would have an I.Q. of $100 + (3 \times 2) = 106$. I.Q.s for 237 cases of all ages gave a mean of 100 and a sigma of 16.

The validity of the test, as has already been mentioned, has been checked 1) by age-grade progress not only on the whole test but for each item of the test; 2) the test has also been given to 97 inmates of the Lincoln State School and Colony, Lincoln, Illinois. For a report on 73 of these cases the writer is indebted to William Sloan, psychologist at that institution. The following is a summary of these results.

Twenty-eight cases classified as spastics and convulsive patients: mean age of 27 months had a mean I.Q. of 6.2 as determined by a method similar to that proposed above.

Twelve were mongols with a mean age of 7 months and mean I.Q. of 23.6.

Twenty-three were hydrocephalics and microcephalics, mean age 14 months and mean I.Q. of 8.1.

Ten miscellaneous cases had a mean age of 16 months and mean I.Q. of 24.4.

These are approximately the scores to be expected of these groups of feeble-minded children.

Of these groups, 29 were also tested either with the Kuhlmann-Binet or Cattell test. The mean difference in I.Q. between the Northwestern test and others was 3.8. In general there is close agreement in test results. The Northwestern, of course, has many more items for use at early ages than either the Kuhlmann-Binet or Cattell tests.

Several of the normal infants who were tested by one of the earlier forms of the test have been given the Stanford-Binet Tests later. While the numbers are too small for statistical analysis, the results thus far have shown high predictive value for the early tests.

The reliability of the tests by the odd-even method, as already stated, was .84. In the earlier form of the test it gave similar results (.87) by the retest method with 4 weeks between tests.

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In summary, a test of 40 items has been constructed with relatively high reliability and evidence of high validity. The test is now to be used to study three problems: 1) To determine whether new norms must be established because the test items have sometimes been taken out of their old settings and partly rearranged in the new test; 2) to test more carefully its predictive value for later attainment; 3) to compare the scores for babies from families with different socio-economic and intellectual backgrounds to determine how early such influences affect test scores.

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PREDICTABILITY OF LEG LENGTH

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The prediction of adult leg length is of considerable importance in the case of children who have had paralytic poliomyelitis. For this reason, some of the material relating to growth in leg length from the Harvard Growth Study has been analyzed. The monograph, *Data on the Growth of Public School Children* (1), includes measurements on a group of 200 white girls of northern European extraction. Anthropometric data are available for this group at each year of age from 7 through 16. Age at the first menstruation is known for 64 of the 200 girls. The methods used in taking the measurements are described in the monograph.

Leg length was not measured directly but was considered to be the difference between the standing and sitting height. This method of estimating the length of the long bones may well be biased, since considerable variation may be introduced into the sitting height by the inclusion of fat and muscle. The measurements studied were:

- 1) Leg length in centimeters at each age, 7-16;
- 2) Standing heights in centimeters at ages 7, 12, and 16;
- 3) Ratio of leg length to standing height at ages 7, 12 and 16;
- 4) Age at first menstruation when it was recorded.

Three problems may be considered. The first is the increase in leg length from year to year and the correlation between the measurements at the different ages. The second is the error in the prediction of leg length at age 16 from different combinations of the variables—leg length, standing height and ratio at age 7 and at age 12. The third problem consists in determining whether the age at first menstruation affects the predictions. It should be stated that because the leg length is a derived measurement, little emphasis can be placed on small differences.

GROWTH IN LEG LENGTH

Table 1 gives the means, increments, standard deviations and coefficients of variation of the leg length at ages 7 through 16 and the means, standard deviations and coefficients of variation of height and ratio at ages 7, 12 and 16. The maximum increase in leg length occurs on the average between the ages of 10 and 11. It has been shown by Shuttleworth (2), on the material from which these 200 cases were selected, that the age of maximum growth differs for various linear dimensions. That of leg length, for example, precedes that of sitting height by about one year. That growth in height and growth in leg length do not proceed in like manner is indicated by the ratios. The ratios were tabulated only at ages 7, 12 and 16. Age 12 shows the highest value.

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The coefficients of variation are of some interest. Those for leg length tend to be greater than those for standing height, while those for the ratio are the smallest of the three.

TABLE I
*Means, Increments, Standard Deviations and
Coefficients of Variation of Leg Length, Height and Ratio*

Age*	LEG LENGTH				HEIGHT			RATIO		
	Mean cms.	Increment cms.	S.D. cms.	C.V.	Mean cms.	S.D. cms.	C.V.	Mean	S.D.	C.V.
7	54.93		3.42	6.2%	120.94	5.44	4.5%	.4540	.0113	2.5%
8	58.12	3.19	3.55	6.1						
9	61.50	3.38	3.77	6.1						
10	64.94	3.44	4.06	6.3						
11	68.50	3.66	4.39	6.4						
12	71.96	3.46	4.25	5.9	150.16	7.50	5.0	.4790	.0112	2.3
13	74.31	2.35	3.98	5.4						
14	75.38	1.07	3.70	4.9						
15	75.75	.37	3.77	5.0						
16	75.82	.07	3.89	5.1	161.20	5.67	3.5	.4703	.0121	2.6

*Ages were measured to the last birthday. Age 7 means between 7 and 8 years.

The coefficients of correlation between the leg lengths at the various ages, between the heights and between the ratios for certain of the ages are given in Table 2. As might be expected, the coefficients between the leg lengths decrease as the difference between the ages increases. The correlation for consecutive ages is lowest for the pair of ages 13-14. Study of the table reveals one curious fact. Leg lengths at ages 10 and 11 correlate less strongly with leg lengths at ages 13, 14, 15, 16 than do the leg lengths at younger or older ages. For example, the correlation coefficients of leg length at 16 with that at 9, 10, 11, 12 are .75, .72, .70, .77. The correlation coefficients between the heights and between the ratios were not computed for all pairs of ages, so that it is impossible to determine if the same decrease is present for these two variables. However, Wilson (3), gives similar banks of correlation coefficients for height and for weight. These were

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computed on measurements of 275 girls from the same source. The group of 200 northern European girls studied here are included in Wilson's 275. Study of Wilson's table shows that the correlation coefficients between the

TABLE 2
Correlation Coefficients between Leg Lengths at Different Ages

Age	8	9	10	11	12	13	14	15	16
7	.965	.959	.934	.909	.900	.866	.788	.745	.728
8		.972	.954	.933	.921	.890	.809	.765	.744
9			.975	.956	.939	.895	.812	.762	.746
10				.972	.945	.891	.797	.737	.719
11					.956	.892	.785	.719	.705
12						.945	.854	.783	.767
13							.926	.864	.847
14								.959	.945
15									.975

*Correlation Coefficients
between Heights*

Age	12	16
7	.882	.752
12		.705

*Correlation Coefficients
between Ratios*

Age	12	16
7	.728	.650
12		.793

heights vary in the same way as do those between the leg lengths. The correlation coefficients between the weights do not show the decreases to the same extent. These decreases, when they occur, seem to involve the ages of maximum growth.

Because the correlation coefficients between the weights, between the heights and between the ratios were not computed at all ages on this group of 200 girls, it is impossible to compare the banks of coefficients with any precision. Wilson's table of coefficients for weight and height shows that the weight coefficients are higher than the height coefficients for ages 11 and 12 with ages 14, 15 and 16. For other pairs of ages, the height coefficients tend to be higher. The height coefficients computed on Wilson's group of 275 girls are higher than the leg length coefficients computed on the group of 200 girls except at ages 11 and 12 with ages 7, 8 and 9. The leg length coefficients tend to be larger than the weight coefficients for

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ages 7 through 13 with ages 7 through 10, but smaller for the other pairs of ages. The only correlation coefficients available between the ratios are at ages 7, 12 and 16. These coefficients are given in Table 2. While there are too few of them for comparative purposes, it is worth noting that the correlation coefficient between the ratios at age 12 and age 16 is higher than the coefficient between the heights or the leg lengths at the same pair of ages.

The correlation coefficients between height, leg length and ratio at ages 7, 12 and 16 are given in Table 3. The height and leg length relationship decreases with age while the coefficients involving the ratio are lowest at age 12.

TABLE 3
*Correlation Coefficients between Leg Length, Height
and Ratio at Ages 7, 12 and 16*

	Age 7	Age 12	Age 16
r _{HL}	.934	.916	.879
r _{HR}	.542	.163	.385
r _{LR}	.796	.527	.702

PREDICTION OF LEG LENGTH

Regression equations for the prediction of leg length at age 16 have been computed. The predictions were based on the combinations of the variables available at ages 7 and 12, namely leg length, height and ratio. The regression equations and the residual variances are given in Table 4. The variance (σ^2) of leg length at age 16 is 15.1. This variance is equivalent to a standard deviation of 3.89 cms. (Table 1). The value, 3.89, represents the amount of scatter about the mean leg length, 75.82 cms., at age 16. The square roots of the residual variances given in Table 4 show the amount of scatter to be expected in leg length at age 16 if the given combinations of variables at ages 7 and 12 are used for prediction purposes.

Inspection of the table shows that, in general, the residual variances are smaller (i.e., the predictions are better) when the predictions are made from the measurements at age 12 rather than from those at age 7. This is not surprising since growth is more nearly complete at age 12. The single exception occurs when the prediction is made from height alone. Leg length at age 16 is better predicted from height at age 7 than from height at age 12.

Various combinations of the variables, height, leg length and ratio, have been used as the bases for the predictions of leg length at age 16. When

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the predictions are made from measurements at age 7, residual variances of 7.12 or less are observed for five out of the possible seven combinations of the three variables. The residual variances for the five combinations

TABLE 4
Regression Equations and Residual Variances for
the Prediction of Leg Length at Age 16

	Height	Leg Length	Ratio	Constant	Residual Variance
<i>Predictions from age 7</i>					
<i>From 3 variables</i>					
Leg length at age 16 =	+ .517H ₇	— .395L ₇	+ .173.5R ₇	— 43.8	6.92
<i>From 2 variables</i>					
L ₁₆ =	— .047H ₇	+ .898L ₇		+ 32.2	7.11
L ₁₆ =		+ .733L ₇	+ 36.3R ₇	+ 19.1	7.06
L ₁₆ =	+ .341H ₇		+ 124.3R ₇	— 21.8	6.94
<i>From 1 variable</i>					
L ₁₆ =		+ .828L ₇		+ 30.3	7.12
L ₁₆ =	+ .480H ₇			+ 17.8	8.32
L ₁₆ =			+ 213.6R ₇	— 21.2	9.36
<i>Predictions from age 12</i>					
<i>From 3 variables</i>					
L ₁₆ =	— .450H ₁₂	+ 1.439L ₁₂	— 5.1R ₁₂	+ 42.3	4.52
<i>From 2 variables</i>					
L ₁₆ =	— .435H ₁₂	+ 1.407L ₁₂		+ 39.9	4.52
L ₁₆ =		+ .525L ₁₂	+ 127.8R ₁₂	— 23.2	4.74
L ₁₆ =	+ .245H ₁₂		+ 205.6R ₁₂	— 59.4	5.05
<i>From 1 variable</i>					
L ₁₆ =		+ .703L ₁₂		+ 25.2	6.23
L ₁₆ =	+ .295H ₁₂			+ 31.5	10.25
L ₁₆ =			+ 232.2R ₁₂	— 35.4	8.33

range from 6.92 (height, leg length and ratio) to 7.12 (leg length alone) and do not vary effectively. It would seem that leg length at age 16 can be as effectively predicted from leg length at age 7 as it can from leg length, height and ratio at age 7. Knowledge of the height and ratio at age 7 does not seem to increase the accuracy of the prediction.

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The situation is practically the same when the predictions are made from measurements at age 12. Combinations of two of the variables appear to be as effective as the three used simultaneously. The residual variances range from 4.52 to 5.05. Leg length alone with a residual variance of 6.23 seems to be only slightly less effective.

Comparison of the regression coefficients in the two equations which involve the three variables shows that there are large differences between the coefficients. Height, for example, at age 7 has a regression coefficient of $+0.517$, while height at age 12 has a coefficient of -0.450 . The differences between these coefficients is more apparent than real since the coefficients in either of the equations are themselves correlated, and within a correlated system, different proportions of the total variance will be thrown from one to another of the variables by minor sampling variations (4).

EFFECT OF AGE OF FIRST MENSTRUATION ON THE PREDICTIONS

It has been shown in the preceding section that very little additional accuracy in the prediction of leg length at age 16 can be obtained from the knowledge of the height and ratio at ages 7 or 12 than can be obtained by the knowledge of leg length alone at ages 7 or 12. Shuttleworth, in studying the material from which these 200 cases were selected, has found that "the menarche is associated with (a) physical size and (b) the timing of changes in the differential patterns of physical growth." The age of the first menstruation is known, unfortunately, for only 64 out of the group of 200 girls studied here. Nevertheless, it is of some interest to determine how the prediction of leg length at age 16 is affected by the menarche in this small group. Table 5 presents the information which relates to this group. Comparison with Table 1 shows that these 64 girls for whom the menarche is known are, on the average, slightly taller and have slightly longer legs than the group of 200 from which they come. While these differences are not "statistically significant," they do suggest that this small group does not constitute a random selection from the larger group of 200. Table 5 shows that the leg lengths and the heights at a given age vary with the age of the first menstruation. Shuttleworth has discussed the character of this variation in detail on the basis of the larger series. The ratios at a given age do not show the same pronounced variation with the menarche as do the heights or the leg lengths.

The table gives two series of values for the predicted leg lengths at age 16. These predicted values were obtained from the two regression equations which involved the three variables, height, leg length and ratio at ages 7 and 12 respectively. The last two columns of the table show the average differences between the observed and predicted values of leg length at age 16 for the six groups of girls whose menarches occurred at the

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stated ages. That these differences are systematic is obvious. The predictions of leg length at age 16 for girls whose first menstruation occurs early are too high while the predictions for girls whose first menstruation occurs

TABLE 5
Leg Length, Height and Age at First Menstruation

Age of first menstruation	Number in group	Leg length in cms. at age			Height in cms. at age		
		7	12	16	7	12	16
Before 11-6	7	55.0	73.4	74.8	121.4	154.6	160.3
11-6 to 11-11	6	56.6	74.1	74.3	124.1	156.1	160.3
12-0 to 12-5	10	56.2	73.0	74.8	124.2	155.7	161.0
12-6 to 12-11	14	55.6	73.7	76.2	122.3	153.9	161.6
13-0 to 13-5	21	56.0	73.4	76.7	122.1	152.2	162.9
After 13-6	6	53.4	71.8	77.1	118.8	149.4	163.6
TOTAL	64	55.65	73.33	75.89	122.28	153.48	161.86

Age of first menstruation	Ratio at age			Leg length at age 16 predicted from ages		Observed—Predicted leg length at age	
	7	12	16	7	12	7	12
Before 11-6	.454	.475	.468	75.9	76.0	—1.10	—1.16
11-6 to 11-11	.454	.475	.461	76.8	76.3	—2.49	—1.99
12-0 to 12-5	.454	.469	.464	76.9	74.8	—2.13	— .08
12-6 to 12-11	.455	.479	.471	76.4	76.7	— .22	— .54
13-0 to 13-5	.458	.482	.471	76.6	77.0	.08	— .27
After 13-6	.450	.480	.471	74.6	75.9	2.55	1.23
TOTAL	.4552	.4776	.4688	76.35	76.30	— .46	— .41

late are too low. This statement is true irrespective of which of the regression equations presented in Table 3 is used. The residuals from the equations involving ratio alone behaved less systematically than do those from the other equations, but the residual variances from these equations were, themselves, large.

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SUMMARY

Certain material from the Harvard Growth Study relating to the growth of leg length and the prediction of leg length at age 16 has been analyzed. It appears that accurate predictions at age 16 cannot be made from leg length, height and ratio at ages 7 or 12. Consequently, if the predictions are to be made more precise, it becomes necessary to consider other variables. Age of the first menstruation is apparently one variable which influences the prediction considerably; but if the predictions are to be made from age 7, this variable will not be known.

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PREDICTION OF ADULT STATURE

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The Problem. The physician is often faced by an anxious mother leading a daughter whom she fears is going to be too tall, or a son whom she fears is going to be too short. Usually no physical disorder can be detected, and therefore the physician's part resolves into reassurance. This he can do more convincingly when he has a method of forecasting the child's probable adult height. Several such methods will now be discussed: Height for age (8, 9), mid-parent rule, Bayley's (1, 2, 3, 4) bone-age method, Walford's transformation (11).

Height for Age. The time-honored method has long been to plot the child's stature and compare it with some so-called normal curve. A considerable choice of such standards is available in the pediatric journals but notably fewer in the text-books. The authorities differ markedly, so that even when the physician goes to the pains of picking the standard most appropriate to the child in question, the comparison would prove so unconvincing or depressing to the mother that he prefers to dismiss printed standards as arbitrary and to reassure her on his own authority. Nevertheless, emphasizing firmly the proviso of selecting a table based on children of racial and environmental similarity to the patient, a reasonable estimate can often be stated for the expected zone of normal variation for the child's present age. Often this estimate indicates no extreme stature and reassurance is simple. Or when the predicted value deviates markedly from the general run, say in the lowest or highest 5 per cent of heights for that age, then one can recommend special attention to diet, vitamins, avoidance of infections; and, when they occur, more diligent attention to them than would be necessary ordinarily. Above all, the doctor should see the child every three months for a year or more; partly to watch the rate of growth, but also to win the child's confidence and trust, in order to lead him to accept his difference from the average as "one of those things," i.e., one of those personal variations that we all have to face sooner or later and make the best of.

Mid-parent Rule. The stature of the parent of the other sex than the child is converted to a same-sex estimate, reducing the father's height by $12/13$; i.e., 0.923, or enlarging the mother's height by $13/12$; i.e., 1.08 (7). For example, for the girl J. in Table 2 below, the father's height 1819 mm. $\times .923$ was 1679, the female equivalent. Averaging this with the mother's 1659, we predict for the child 1669 mm. Since at the age of 25 she was 1683 mm. tall, this prediction was 14 mm. or 0.8 per cent too small. The forecast in this case was gratifying. The general precision of this method has never been studied, but may be roughly estimated from

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the evidence in the 53 cases here collected. The percentage error varied from 8.4 too small to 1.4 too large, and averaged without regard to sign 2.8 per cent.

Bayley's Bone-age Method. In a study exceptional for comprising observations of many characteristics from birth to maturity (2), she demonstrated that mature size can be predicted with notable accuracy if a child's present size and skeletal age are known. There also appeared to be one type of comparison in which sex differences practically disappeared; when she controlled the degree of skeletal maturity, by adjusting for the two-year sex difference in bone maturity during these adolescent years, then the growth curves for per cent of mature height were closely similar for the two sexes.

Dr. Bayley has kindly furnished annual statures on 21 boys and 22 girls. These amplified the smaller series which I had collected of ten cases, unfortunately lacking bone-ages, but making 53 in all for various parts of this study. Now, on applying Walford's transform, which is treated in the next section, I predicted mature heights by use of her measurements through the sixth birthday in 3 cases, the seventh in 3, the eighth in 9, the ninth in 12, the tenth in 7, the eleventh in 4, the twelfth in 3, and the thirteenth birthday in 2 cases. Then, for comparison, Dr. Bayley was asked to make her predictions, availing herself only of her standards up to those respective ages. The deviation or error, expressed as a percentage of the latest observed height, which is assumed in this paper to be approximately the adult value, came out as follows. Her predicted values were sixteen times on the plus-side and twenty-seven on the minus-side; i.e., her method tended slightly to underestimate the future mature height. The error ranged from plus 3.3 per cent to minus 7.3 per cent, and the average for the 43 children without regard to sign was 2.0 per cent. When the latest age allowed her for prediction was the 6, 7 or 8th birthday, her error averaged 1.8 per cent, and when the 9th, 10th, 11th, 12th or 13th birthday, the error averaged 2.2 per cent; rather the reverse of what would be expected. Since the errors of methods current in the practice of medicine are of the order of 5 per cent, or even 10 per cent, the average just found is admirable. Also it was smaller than the 2.7 per cent error resulting from applying the transform to these same cases.

Walford's Transformation. This ingenious device can be applied graphically, and then if desired computed more exactly. One merit is that it requires only annual heights and saves the expense of bone-ages by X-ray. Another merit is that the graph yields a straight line, which is much simpler to interpret than the conventional curved lines for height on age. The error of prediction will be shown later in this paper.

The essence of Walford's device, instead of the conventional manner with age on the horizontal, and stature on the vertical scale, is to plot stature at a given birthday on the x -axis and stature at the next birthday on

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the y -axis. As many such points are plotted as there are available heights at yearly intervals. He noticed, on omitting some points out of the stream, that a line fitted by least squares to the remaining points evidenced by its slope the percentage relative rate of growth, apparently *fixed early in the life of the individual*.

His working-units were the actual measurements in millimeters, and his data were group-averages. His principle is extended in this paper both to series of group-averages and to series for different individuals, plotting each series and computing the straight growth-line. And this was done both in his working-units of millimeters of height, and also in natural logarithms of those heights. Theoretically, the log units, which define the instantaneous percentage growth-rate, have been advocated as superior by sundry writers (5, 9). And practically, the parallel trials mentioned yielded smaller errors in prediction for the log units. This modification of Walford's transformation will now be presented in detail, and will be referred to as the transform.

METHOD PROPOSED FOR HEIGHT-PREDICTION

The successive steps of the procedure here advocated, will be demonstrated as a paradigm (Table 1).

1. Age is shown in the first column. For the particular series here shown it is the center of the age-range, e.g. $1 = 0.5$ to 1.5 years. For the study of an individual the measurement should be made on or near the birthday; if not, then one takes a large sheet of cross-section paper about 21×16 inches, ruled 10 lines to the inch, such as Dietzgen's No. 360, plots the heights against ages and fractions as exactly as possible, fits a smooth curve with a spline, reads off heights at even birthdays, and lists these in column 2.

2. Stature, in the second column, is a series of statures used, here the averages, for varying numbers of private school girls, 1466 in all (6). They have been plotted and smoothed graphically with resulting slight adjustments of the original averages for the ages 13, 15, 17, and 18.

3. The natural logarithm of stature, or, for convenience in entering a Table of Natural Logarithms (the best is given in References (10)), $\ln(S/1000)$, is read off and listed in column 3. Each of these is the value x at a given age A , corresponding to Walford's length l at age n . The abbreviation A is here preferred to n , because that is so universally used to denote the number of cases.

4. The logarithm of stature one year later, denoted as y at age $(A + 1)$, corresponding to Walford's length at age $(n + 1)$ is entered on each line in column 4 by reading from the prior column the value on the next lower line. Then the data x, y are used for plotting and computing throughout, until the very end, when the final predicted limit of growth will be reconverted by the table into millimeters of stature.

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5 and 6. The extensions x^2 , xy were carried out to 6 decimal places, so that the totals come from those original calculations and occasionally differ slightly from the totals of the items in the paradigm table.

TABLE I
1466 Private School Girls

Age (1)	Stature in mm. (2)	x (3)	y (4)	x^2 (5)	xy (6)
1	754	— .2824	— .1578		
2	854	— .1578	— .0419		
3	959	— .0419	.0344	.0018	— .0014
4	1035	.0344	.1053	.0012	.0036
5	1111	.1053	.1664	.0111	.0175
6	1181	.1664	.2159	.0277	.0359
7	1241	.2159	.2677	.0466	.0578
8	1307	.2677	.3067	.0717	.0821
9	1359	.3067	.3373	.0941	.1034
Sums:		1.0545	1.4336	.2541	.2989
Means:		.1506	.2048		
10	1401	.3372			
11	1461	.3791			
12	1520	.4187			
13	1568	.4498			
14	1601	.4706			
15	1620	.4824			
16	1629	.4880			
17	1635	.4916			
18	1640	.4947			
19	1646	.4983			

7. Lay-out of the diagram. Take a sheet of paper ruled 10 to the inch, such as the common 10 X 8 inch size, and beginning at the left lower corner, lay off identical scales covering the range of values from the first to the last in column 3. Usually, at each heavier inch ruling, the figures

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will be: $-.30, -.20 \dots 0, .10, .20 \dots 50$. Thus we get a lay-out like Figure 1.

8. The 45 degree line. From the joint origin of the scales in the left lower corner, draw a 45-degree diagonal up across the diagram. Its theory was given by Walford but can be ignored by us. Its practical use will be seen later.

9. Plotting the points. From the first row recorded, the values x, y are plotted as a circle about 1-2 mm. in diameter, and this process is repeated for each successive row.

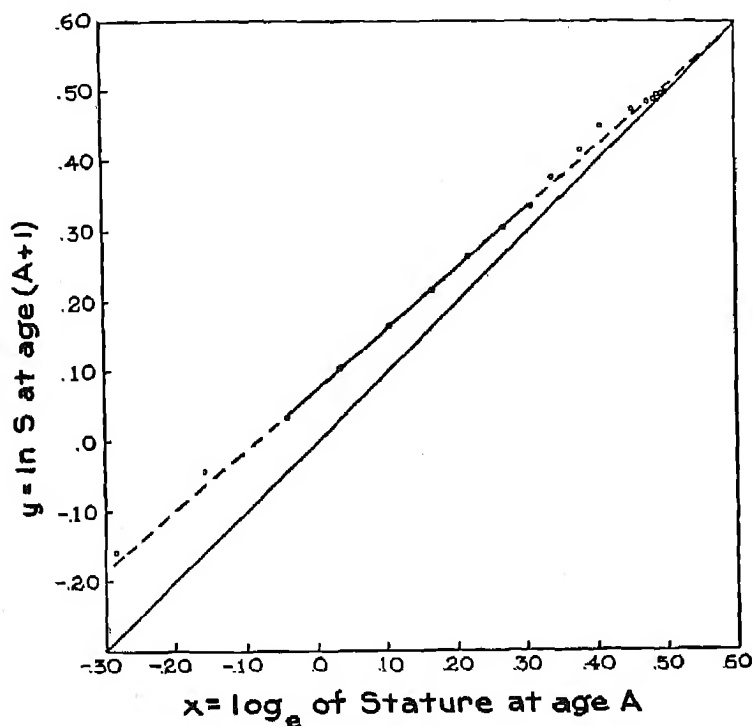


FIGURE 1

10. The preliminary prediction-line by eye. Inspection of the stream of points will now show some remarkable phenomena.

(a) At earlier ages, i.e., to the left, a couple of circles usually lie plainly above the line, and are to be neglected.

(b) At later ages of adolescence, i.e., off to the right, the circles take the course of a curve, first up then down again until they meet the prediction line to be defined. They also are to be neglected.

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(c) This is the cardinal feature. An impressive number of the circles lie so nearly in a straight line that they touch a celluloid straight-edge. The number of these varies from 3 to 10 and usually corresponds to the range of ages 4 to 9 years, occasionally 2 to 12 years. In the present series the range is for the 7 circles from ages 3 to 9 in column 1. This line is ruled in heavy over this range, and dashed off to the left, and to the right until it joins the 45-degree diagonal. The value at the junction reads identically on both axes; i.e., $x = y$, that is, the value at some age A (just what age, is secondary) will be equal to that at next age $(A + 1)$. That value will be mature height, as near as can be forecast graphically. Now we shall get it more accurately by computing.

11. The equation for the prediction-line. We return to Table 1 and rule two lines across to delimit the range of 7 rows specified in the preceding paragraph. We add columns 3, 4, 5, 6 to get the sums $S(x)$, $S(y)$, $S(x^2)$, $S(xy)$. These sums, and the number of points $n = 7$, enable us to compute the conventional formula for k , the slope of the regression line:

$$k = [S(xy) - n \bar{x}\bar{y}] / [S(x^2) - (Sx)^2/n],$$

whence $k = .872$, and E the expected value of y at any x is:

$$E = \bar{y} - k\bar{x} + kx = .0735 + .872x;$$

which, it is to be emphasized, is the value of y at any x .

12. The limiting length. The exact value of y when it equals x , i.e., where the main line joins the 45-degree diagonal, where growth ceases, is easily got by Walford's equation 5, which may be written:

$$L = \text{intercept}/(1 - k) = (\bar{y} - k\bar{x})/(1 - k) = .0735/.128 = .574;$$

which agrees with the graph. This logarithm could now be re-converted to 1776 mm., but that is plainly too large, as is also the case with the 53 individuals studied; the reason is that this limiting value L theoretically estimates the asymptote approached as a limit, but certainly not actually attained until after tiny gains in the 20's or even 30's and practically turns out therefore always larger than the height actually observed at the so-called adult age of say 20 years. Therefore, a further modification of Walford's work is needed by the introduction of a correction factor.

13 a. Correction factor and corrected limiting length (female). We may take

$$c = \text{observed/predicted} = \text{adult } x/L, \text{ here } .4983/.5742 = .8678,$$

which is therefore recommended as a correction to improve the limiting equation calculated from any female series, whether a series of group aver-

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ages or a series of heights for one individual girl. The corrected limit or final forecast of adult height is:

$$cL = .8678L = .8678(\bar{y} - .872\bar{x}) / (1 - .872) = 6.7793\bar{y} - 5.9115\bar{x},$$

which should estimate a corrected limit identical with the natural log of the oldest stature listed, what I called the "adult" x ; that was .498, and solution of the above equation gives the same. For other female series, naturally, this fixed correction factor does not yield a perfect outcome, but it seems the best overall estimate at present. The \bar{x} and \bar{y} are got from the calculations for the individual under examination. These successive steps are displayed in Table 2.

TABLE 2
Work-Sheet for Girls

Assuming slope $k = .872$, i.e., that found from Private School Girls, and similarly correction = .8678

	Pri. Sch.	Joan	Barbara	Peggy	Bayley's No. 120
1) \bar{y}	.2048	.2100	.1886	.2230	.1560
2) \bar{x}	.1506	.1489	.1195	.1587	.0916
3) $k\bar{x}$	.1313	.1298	.1042	.1384	.0799
4) $\bar{y} - k\bar{x}$	.0735	.0802	.0844	.0846	.0761
5) $(\bar{y} - k\bar{x}) / (1 - k) = \log_e L$	.5742	.6265	.6593	.6609	.5945
6) $\log_e(\text{latest "adult" } S/1000)$	.4983	.5206	.5895	.5755	.5092
7) $(6)/(5) = \text{corr. factor}$	.8678	.8678	.8678	.8678	.8678
8) $(5) \times \text{factor} = \log(cL)$	.4983	.5437	.5721	.5735	.5159
9) $[(8) - (6)] / (6)$	0	+4.4	-3.0	-0.3	+1.3
10) Solution of Equation in Paragraph 13 = $\log(cL)$	.4981	.5435	.5722	.5736	.5161

13 b. Correction factor and corrected limit (male). The same procedure applied to 3110 private school boys, gives the correction factor $c = .9411$ and the corrected limit or the final prediction of mature height as:

$$cL = .9411L = 7.842\bar{y} - 6.901\bar{x}.$$

14. Slope assumed constant for sex. When we proceed to the study of individuals, we find of course that the slope varies from person to person. One might be disposed to use for each the personal slope. Unfortu-

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nately in some children the graphic line is nearly parallel to the 45-degree line, i.e., its slope approximates 1.00. In such instances the lines will take so long to meet that the mature value is obviously ridiculous, and the method fails us. Judging from several trials, any series of points yielding a calculated regression line with a slope of .90 or more indicates that that child's line is too nearly parallel to the 45-degree line, therefore would predict an absurd adult height, and makes the method useless for that particular child. Hence one is led to consider using a constant slope for the sex. Trial of this hypothesis has shown that the error of prediction is reduced and simplicity is greatly increased. An obvious assumed value of the slope k constant for females is that magnitude just computed for the series of private school girls. So with $k = .872$ the individual series were computed, and 4 of them are shown in the table as examples. The corresponding k from the series of private school boys was .880.

Another assumption for a fixed k might be the average of k 's obtained from a number of individual series; thus from 11 female series taken at random the average k was .850, which is reasonably close to .872, the value chosen; and for 9 male series the average slope was .890, which again is satisfactorily near to .880 as chosen; this alternative assumption was not used in the present work.

15. Error of proposed method. To measure this for each individual we take $100(cL - \text{Obs.}) / \text{Obs.}$, where cL is the corrected limit predicted and Obs. is the observed "adult height." In passing it may be noted that in our female series the ages ran from 15 to 25, average 18.3, and in the male series 17 to 22, average 18.1 years.

The percentage errors for 29 girls varied from -7.2 (too low prediction) to $+5.5$ (too high forecast), with an average disregarding sign, of 2.5. For 24 boys, the percentage errors ran from -8.0 to $+5.3$, averaging without regard to sign 2.4. For all 53 the average error was 2.5.

16. Final predicted adult stature. The last step is to reconvert the logarithmic working-units into original units of millimeters to obtain the desired adult size or limit of length, which Walford terms length at infinity and here is written more simply as L .

SUMMARY

Three methods of forecasting the adult stature in children are presented. The respective percentage-errors of prediction were:

Mid-parent rule	2.8
Walford's transform	2.5
Bayley's bone-age	2.0

The last named method is the best, but none the less the other two may at times be serviceable.

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BODY SIZE IN INFANCY AND CHILDHOOD: A COMPARATIVE STUDY OF DATA FROM OKINAWA, FRANCE, SOUTH AFRICA, AND NORTH AMERICA

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This paper focuses attention upon racial differences in body size during the first decade of life. It brings together findings from studies on Okinawans; South African Bantu-speaking Negroes; North American Negroes; American Chinese and Japanese residents of California; Alaskan Eskimos; Mexicans living in California, Texas and Mexico; Navaho and Pueblo Indians of New Mexico and Arizona; European Whites living in Marseilles, France; and North American Whites of the United States and Canada.

The writer's objective is twofold: to add to our knowledge of racial differences in childhood, and to aid in bringing teachers and writers on racial differences abreast of the known facts. Knowledge of racial differences is enhanced in part by "the accumulation and analysis of original anthropometric data" and in part by "compilation and synthesis of existing studies" (30, p. 1). The present paper is primarily the fruition of research activity of the latter type. It colligates the results from more than fifty investigations and attempts to strengthen our working foundation of fact on racial differences in childhood.

It is hoped that teachers and writers will find the paper a "serviceable source" on the problem of childhood racial differences. Too frequently in contemporary child growth literature this problem is treated erroneously or discussed in unnecessarily indefinite language. As an example of flatly erroneous statement, the following is taken in slightly veiled form from a 1946 textbook: During childhood, races differ very little in body size; it is *not until puberty* that racial differences are manifested.

The immediate spur to preparation of this paper arose from a recently reported study by Newman and Eng (37). Besides presenting an original analysis of anthropometric data collected on Okinawans in 1945, these authors compared Okinawa children with Japanese children. Interest in this particular comparison followed from an early period of similar racial history. To quote: "It is probable that the first inhabitants [of Okinawa] were Ainu-like people from the main Japanese islands. In the first or second millenium B.C., Southern Mongoloid people entered Japan, presumably via Korea, and pushed south. . . . There is no evidence that later arrivals in Japan" affected Okinawa (37, p. 152). In other words, present-day Okinawans have "higher proportions of Ainu and Southern

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Mongoloid than the Japanese themselves" and lack "the Northern Mongoloid strains later entering Japan" (37, p. 153).

The Newman and Eng findings merit alignment with findings on children of a number of ethnic groups. They would fall far short of their potential usefulness to those interested in child growth if no one discharged the task of setting them in a broad comparative framework.

BIRTH

Newman and Eng report averages for weight, stature, and head circumference based upon measurements of 56 Okinawa newborn infants. In Table 1 these averages are brought into juxtaposition with averages for North American infants of Negro, Mexican, Japanese and White ancestry.

The Negroid value for weight is the combined mean from studies by Anderson, Brown and Lyon (1); Bakwin (2); Baldwin (4); Bivings (5); Duffield, Parker and Baumgartner (10); Dunham, Jenss and Christie (11); Meyer (34); Michelson (36); and Pasamanick (39). The Negroid stature value is that obtained from two discrepant averages, one reported by Meyer (34) on 1,027 infants born at Baltimore, Maryland, and the other by Pasamanick (39) on 35 infants born at New Haven, Connecticut. Goldstein (14) recently made available the weight and stature means for neonates of Mexican parentage; these are based upon data obtained partly in San Antonio, Texas, and partly in Guanajuato, Mexico. Unfortunately, published research to date does not include averages for head circumference on North American newborns of either Negro or Mexican descent. The weight, stature, and head girth values for Mongoloids are taken from Ito (21), and represent neonates of Japanese parentage born 1932-35 at Los Angeles, California.

For North American White infants, it was possible to draw materials from numerous investigations. Large samples were amassed on all three measurements; to wit, over 10,000 newborns on stature (see 30, p. 14), approximately 5,000 on head circumference (see 31, p. 56), and over 100,000 on weight (1, 3, 5, 6, 8, 10, 11, 12, 15, 16, 18, 32, 34, 42, 43, 47, 51, 52, 53).

Table 1 supports the following findings:

1. Mean weight is appreciably less for Okinawa newborn infants than for newborn infants of North America. Specifically, the Okinawa infants are lighter than the White infants by 0.60 kg. (1.3 lb.), lighter than the infants of Japanese ancestry by 0.44 kg. (1.0 lb.), and lighter than the Negro and Mexican infants by 0.40 kg. and 0.37 kg. respectively. In no instance—for rejection of the null hypothesis at the 1 per cent level of confidence—is it required that the difference exceed 0.20 kg.

2. Okinawa neonates tend to be shorter in stature than North American neonates of White, Mexican and Japanese lineage, but not shorter than North American Negro neonates. More explicitly, results from tests of

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statistical significance are in accord with the inference that in relation to Okinawans, North American Negroes are shorter,¹ and North American Japanese, Mexicans and Whites longer. With one exception the significance ratios exceed the critical values for confidence at the 1 per cent level.

TABLE I
BODY SIZE MEANS ON FIVE GROUPS OF NEWBORN INFANTS
Each mean represents infants of both sexes.

Group	Weight (kg.)		Stature (cm.)		Head Girth (cm.)	
	N	Mean	N	Mean	N	Mean
Okinawans	56	2.80	56	49.2	56	33.4
U.S. Negroes ¹	14,034	3.20 ²	1,062	48.6 ³		
Mexicans ⁴	210	3.17	181	50.1		
U.S. Japanese ⁵	202	3.24	202	49.8	202	33.9
North Am. Whites ⁶	108,715	3.40	10,663	50.3	4,967	34.2

¹Data for weight collected in New York, Connecticut, Maryland, Ohio, and Georgia; data for stature in Maryland and Connecticut.

²Mean birthweight is known to exceed median birthweight by approximately 0.05 kg. (1). Consequently, this amount was added in the case of studies (11, 34) reporting medians but not means.

³The major study used here gave the median. It has been shown, however, that there is no systematic difference between mean stature and median stature (53).

⁴San Antonio, Texas, and Guanajuato, Mexico.

⁵Los Angeles, California.

⁶United States (New York, Maryland, Massachusetts, Pennsylvania, Ohio, Minnesota, Iowa, Georgia, California) and Canada (Ontario).

The exception is for Okinawans with American Japanese, and here the ratio ($t = 2.1$) is above the needed figure for confidence at the 5 per cent level.² Mean stature for the North American White infants will be seen to be greater than that for the Okinawa infants by 1.1 cm. (0.4 in.), or 2.2 per cent.

¹Reference was made earlier to the discrepant figures for average stature of North American Negroes reported by Meyer (48.5 cm.) and Pasamanick (50.1 cm.). The composite mean of 48.6 cm. ($48.5 \times 1,027 + 50.1 \times 35/2$) is in harmony with the mean reported by Kelly and Reynolds (22) for Detroit Negro infants age 6 weeks—the Kelly-Reynolds mean is 51.6 cm., and it is known that increase in mean stature during the first six postnatal weeks approximates 3.0 cm. (see 30, p. 44). Further, the difference between the composite means of Table 1 for Negro and White newborns (1.7 cm.) is identical with the difference obtained by Kelly and Reynolds between the means for Detroit Negro ($N = 32$) and White ($N = 74$) infants age 6 weeks.

²The standard deviation for stature on the American Japanese subjects was 1.8 cm. No measure of variability was reported on the Okinawa subjects; since their stature was determined by "tape measure," a standard deviation of 2.4 cm. was assumed (see 30, p. 46).

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3. Mean head circumference is smaller for Okinawa infants than for North American infants of Japanese or European descent. In the former comparison the difference in means is 0.5 cm., and in the latter it is 0.8 cm. (0.3 in.). Both these indications of sampling from unlike populations are statistically significant. That is, on the hypothesis of random selection of the subjects representing the different ethnic groups, the null hypothesis may be rejected in each instance at the 1 per cent confidence level.³

It cannot be assumed, of course, that the above findings reflect hereditary differences solely. There are tenable grounds for the position that the groups may differ systematically with respect to other variables. For example, it is probable that maternal diet during pregnancy is not equivalent from sample to sample.⁴

EARLY CHILDHOOD

At ages beyond birth, the Newman and Eng report is restricted to consideration of stature and weight. Correspondingly, the succeeding inter-comparisons of the present paper are confined to these measurements.

Taking age 3 years as representative of early childhood, the attempt was made to compare Okinawans with North Americans of varying ancestry and socioeconomic status. It was found that for White children of low socioeconomic status, the only accessible recent⁵ investigation at age 3 was on females. Since the Okinawa sample had been characterized as poor for diet and health care, use of this low-status-White study seemed desirable. Thus the decision that the materials assembled and presented in Table 2 should pertain to females exclusively.

The Okinawa values given in the first row of Table 2 were derived by a) applying the corrections Newman and Eng specify (37, p. 146) to the appropriate figures from their tables, and b) interpolating. Interpolation was also necessary in obtaining one of the two component means utilized in deriving the stature value of the second row—the mean typifying a sample of 11 Negro females measured in 1935 at the Riverdale Orphanage, New York (35, p. 202). The remaining data of the second row were collected on 11 Negro females in attendance 1941-42 at two WPA nursery schools in Des Moines, Iowa (44, p. 21). Presented in the third row are stature and weight means for 7 Mexican females examined in Mexico and Texas during 1941-42 (13, pp. 70-88).

The last three rows of Table 2 carry means on White females of north-west European ancestry representing different socioeconomic levels. For

³The standard deviation for head girth reported on the American Japanese was 1.2 cm. A standard deviation of 1.3 cm. was assumed for the Okinawa infants (see 31, p. 47).

⁴In this connection, see Burke, Harding and Stuart (7, p. 513).

⁵It is important in racial and socioeconomic comparisons to take cognizance of the secular period in which each series of data were collected. For findings on secular change at early childhood ages, see Meredith (29, pp. 18-19; 30, pp. 11-15).

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the "lower classes" group, two-thirds of the fathers either were unemployed or employed as laborers: the records on this group were obtained 1939-41 at WPA preschools in the vicinity of Birmingham, Alabama (55, p. 168). The subjects which comprise the "middle classes" sample

TABLE 2
STATURE AND WEIGHT MEANS ON SIX GROUPS OF FEMALES
AGE 3 YEARS

Data all collected between 1930 and 1945

Group	Stature (cm.)		Weight (kg.)	
	N	Mean	N	Mean
Okinawans ¹	55	86.1	55	11.3
U.S. Negroes	22	90.3 ²	11	14.5
Mexicans ³	7	88.2	7	13.5
U.S. Whites:				
Lower classes ⁴	20	92.4	20	14.3
Middle classes ⁵	79	94.6	103	14.5
Upper classes ⁶	34	95.7	34	14.7

¹Diet and health care poor (see 37, pp. 146-148).

²Pooled here are two samples of 11 each drawn at an orphanage and at WPA nursery schools. The mean from the orphanage sample is strikingly low—86.6 cm. A mean of 90.6 cm. was secured by Woodbury (57) from 1918-19 data on 209 Negro females living primarily in southern and eastern states, and a mean of 90.9 cm. by Herskovits (17) from 1923-26 data on 28 Negro females residing primarily in New York (Harlem) and West Virginia.

³Mexico and Texas, socioeconomic status "generally low" (13, p. 13).

⁴Alabama WPA nursery schools, mean family income (1939) \$670 annually.

⁵Massachusetts homes of "middle economic circumstances," enrolled from birth in a program which afforded parents "periodic health and nutritional advice" (53, p. 156).

⁶University of Iowa preschools, professional and managerial classes.

fall almost entirely into the semiskilled, skilled, commercial, and minor managerial occupational categories. All were enrolled from birth at the Center for Research in Child Health and Development, Boston, and were the recipients of periodic health examination and pediatric advice (53, pp. 163, 165). The sample for "upper classes" was drawn between 1938 and 1941 at the University of Iowa Preschool Laboratories, Iowa City; "one-third represented the managerial or commercial groups and two-thirds the professional classes" (55, pp. 169-170).

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Findings with reference to Table 2 are:

1. Compared with 3-year-old White children of the United States, Okinawa children at age 3 are markedly shorter and lighter. The means in Table 2 from the "lower classes" sample of White females surpass the corresponding means on Okinawans by 6.3 cm. (2.5 in.) for stature and 3.0 kg. (6.5 lb.) for weight. Matching the Okinawa means from both males and females against the Vickers and Stuart (53) means on middle class, well-cared-for, White children, it is found that the Okinawa 3-year-olds are similar to the Boston 2-year-olds in stature and 1.5-year-olds in weight.

2. The obtained means at age 3 years are larger on the Mexican females than on the Okinawa females by 2.1 cm. for stature and 2.2 kg. for weight. Although these differences have appreciable magnitude, their statistical dependability is heavily handicapped due to the paucity of Mexican subjects. Recognizing this, and having access with both ethnic groups to male as well as female data, tests of significance were made for the two sexes jointly.⁶ In the case of weight, a statistically significant difference was obtained at the 1 per cent confidence level. For stature, however, the difference was not reliable.

3. In relation to 3-year-old Negro children of the United States, Okinawa 3-year-olds are much smaller. The WPA nursery school means obtained by Sessoms (44) on Negro children of both sexes ($N=20$) exceed the Newman and Eng means for both sexes by 6.9 cm. (2.7 in.) in stature and 2.8 kg. (6.2 lb.) in weight. Even the quarter-century-earlier sample of American Negroes studied by Woodbury (57)⁷ surpasses the Newman and Eng sample by 4.7 cm. (1.9 in.) in mean stature and 1.6 kg. (3.5 lb.) in mean weight.

LATE CHILDHOOD

At birth (Table 1) and in early childhood (Table 2), it has been possible to compare Okinawa children with North American children of White, Negro, Mexican and Japanese ancestry. In later childhood, materials are available on each of these groups and also on North American Chinese, Eskimos, and Indians.

Table 3, for stature, and Table 4, for weight, show the mean size of Okinawa children at ages 6 to 10 years in relation to the mean size of ten ethno-socioeconomic groups of North American children and one sample each of French and South African Bantu children. The means of both tables are for males and females together, and in all instances are derived

⁶The number of subjects was increased to 15 Mexicans and 132 Okinawans. For the Okinawans, standard deviations of 3.5 cm. and 1.6 kg. were assumed. For the Mexicans, the stature and weight records of each individual were available.

⁷The number of subjects was 367 at age 3 for both sexes combined.

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TABLE 3

STATURE MEANS (CM.) AT FIVE AGES ON THIRTEEN
GROUPS OF CHILDREN STUDIED BETWEEN 1930 AND 1945

Each mean represents children of both sexes.

Group	Age in years:				
	6	7	8	9	10
OKINAWANS: poor diet and health care (37)	102.0 (240)	106.6 (279)	113.0 (342)	118.2 (420)	122.6 (444)
MEXICANS: Texas & Mexico; low economic level (13)	107.1 (38)	112.5 (39)	117.7 (41)	122.6 (46)	128.2 (49)
SOUTH AFRICAN BANTU (Negro): "inadequate", diet (24)		114.0 (242)	119.0 (407)	123.2 (535)	127.1 (712)
FRENCH: Marseilles; all economic classes (48) ¹	107.8 (62)				128.8 (49)
U.S. PUEBLO INDIANS: barely subsistence level (40) ²	109.3 (275)	114.0 (408)	118.7 (405)	123.7 (407)	129.2 (386)
U.S. CHINESE: Lower and middle classes (41, 56) ³	109.3 (282)	114.3 (292)	119.3 (304)	124.3 (340)	129.0 (366)
U.S. JAPANESE: California; all vocations (25, 41, 50)	110.2 (269)	115.3 (374)	120.4 (516)	125.6 (576)	130.8 (504)
U.S. MEXICANS: Los Angeles public schools (25)	112.4 (1,877)	118.0 (2,180)	123.7 (2,253)	128.8 (2,250)	133.7 (2,253)
NORTH AM. WHITES: Poorest urban districts (19, 54)		118.6 (583) ⁴	123.4 (661)	128.9 (717)	134.4 (678)
U.S. NAVAHO INDIANS: New Mexico and Arizona (46)	114.8 (140)	119.9 (200)	124.9 (236)	130.6 (276)	135.1 (339)
NORTH AM. WHITES: all socioeconomic groups. ⁵	115.0 (20,817)	120.7 (26,292)	126.2 (28,732)	131.5 (30,738)	136.5 (31,738)
U.S. NEGROES: Los Angeles public schools (25)	115.1 ⁶ (363)	121.5 (407)	127.0 (403)	132.8 (428)	137.2 (410)
NORTH AM. WHITES: business and professional classes. ⁷	117.3 (849)	122.6 (1,518) ⁸	128.2 (1,451)	133.6 (1,437)	139.3 (1,538)

¹Sample "probably somewhat weighted on the side of low economic status" (48, p. 424).

²Data collected in New Mexico and Arizona.

³Mainly residents of "Chinatown," San Francisco.

⁴Number of subjects in Hopkins' study (19) apportioned as 400 at each age.

⁵Keyfitz (23), Lloyd-Jones (25), and O'Brien, Girschick and Hunt (38).

⁶Los Angeles' White children were found to be slightly taller at each age.

⁷Simmons (45) and Stuart and Meredith (49) at each age; "best districts" data from Weisman (54) and Hopkins (19) at ages 7 to 10.

⁸Number of subjects in Hopkins' study apportioned as 480 at each age.

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TABLE 4
WEIGHT MEANS (kg.) AT FIVE AGES ON THIRTEEN GROUPS
OF CHILDREN STUDIED BETWEEN 1930 AND 1945
Each mean represents children of both sexes.

Group	Age in years:				
	6	7	8	9	10
OKINAWANS: approximate weight unclothed (37) ¹	16.3 (240)	18.4 (279)	20.3 (342)	22.8 (421)	24.9 (445)
SOUTH AFRICAN BANTU: weight taken nude (24)		19.6 (242)	21.3 (408)	23.0 (536)	24.8 (713)
U.S. CHINESE: approximate weight unclothed (41, 56) ²	17.9 (282)	19.5 (293)	21.4 (305)	23.4 (341)	25.7 (367)
U.S. PUEBLO INDIANS: allowance for clothing (40)	18.3 (275)	19.9 (408)	21.7 (405)	23.9 (407)	26.5 (386)
FRENCH: weight taken with children nude (48)	18.5 (62)				26.3 (50)
MEXICANS: allowance made for clothing worn (13)	19.0 (38)	20.5 (39)	22.5 (41)	24.6 (46)	27.8 (49)
U.S. JAPANESE: approximate nude weight (25, 41, 50) ³	19.0 (269)	21.0 (374)	23.1 (516)	25.5 (576)	28.4 (504)
U.S. NAVAHO INDIANS: allowance for clothing (46)	19.6 (140)	21.4 (200)	23.5 (236)	25.8 (276)	28.3 (339)
NORTH AM. WHITES: low economic status (19, 54) ⁴		21.4 (596)	23.7 (679)	26.2 (687)	29.1 (646)
U.S. MEXICANS: 1.0 kg. off means for clothing (25)	20.0 (1,877)	22.1 (2,180)	24.7 (2,253)	27.2 (2,250)	30.1 (2,253)
NORTH AM. WHITES: all socioeconomic groups ⁵	20.5 (20,817)	22.8 (26,292)	25.3 (28,732)	28.0 (30,738)	31.0 (31,738)
U.S. NEGROES: means lowered 1.0 kg. for clothing (25)	20.5 (363)	23.1 (407)	25.5 (403)	28.6 (428)	31.3 (410)
NORTH AM. WHITES: business and professional classes ⁶	21.4 (732)	23.4 (1,448)	26.2 (1,396)	29.3 (1,406)	32.8 (1,496)

¹"Weighed fully clothed . . . clothing light"; 1.0 kg. deducted from each mean.

²Weighed in one layer of underwear (41) or "clothed below the waist . . . except for shoes" (56). Latter study adjusted by lowering each mean 0.5 kg.

³Weighed nude (50), in one layer of underwear (41), and with shoes, coats and heavy sweaters removed (25). Last means (25) were subjected to a 1.0 kg. reduction.

⁴Reductions of 0.5 kg. for clothing below waist (19) and 1.0 kg. for clothing minus shoes and sweaters (54). Medians (19) were adjusted to approximate means by adding 0.4 kg. at age 7, 0.7 kg. at 8, 1.0 kg. at 9, and 1.5 kg. at 10.

⁵One layer of underwear (38) or 1.0 kg. deduction for clothing (23, 25).

⁶Partly nude (29), partly 0.5 kg. reduction for clothing below waist (54), and partly 1.0 kg. reduction for clothing minus shoes and sweaters (19, 45).

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from data collected within the secular period 1930 to 1945.⁸ Each table is arranged with the smallest series of means appearing in the first row, the series of next higher magnitude in the second row, and so on in rank order to the largest series at the bottom of the table.

The materials used in compiling Tables 3 and 4 are conveniently discussed following the sequence of their presentation in Table 3. *Okinawa children*: In addition to combining for sex, it was necessary—as at age 3—to adjust the Newman and Eng means “for age, weight of clothing and thickness of sandals” (37, p. 146). *Mexican children*: These data were collected in 1941-42 on residents of Texas (mainly San Antonio) and Mexico (Celaya and Guanajuato in Guanajuato, Monterrey in Nuevo Leon, and Saltillo in Coahuila). Goldstein characterized the living conditions for the group as a whole as “generally poor” (13, p. 32). *South African Bantu children*: The subjects were Bantu-speaking Negro school children⁹ in nine areas of the Union of South Africa, three urban and six rural. Their diet was described by Le Riche as “inadequate in amount and quality” (24, p. 25). *French children*: Stuart and Kuhlmann (48) gathered these data in 1941 at Marseilles, France. The sample was drawn partly by enlisting the cooperation of families considered representative of the city, and partly through “the schools.”

Pueblo Indian children: These children, examined at Indian schools during the years 1931-34, “came from 16 pueblos in the Rio Grande valley of New Mexico and 9 Hopi villages of northwest Arizona” (40, p. 150). Their general economic level was appraised as “somewhat above subsistence” and their diet as “inadequate in both quantity and quality” (40, p. 17). *American Chinese children*: The means presented, for both stature and weight, are composite values on children of Cantonese ancestry measured in 1931 through “language and church schools” of San Francisco and Oakland (41), and in 1935 through “public, parochial and private schools” of San Francisco (56). Roughly half of the fathers were unskilled or semi-skilled workmen, and half were engaged in small business, commercial, and skilled occupations. *American Japanese children*: Again, for stature and weight, composite means are given—means derived by pooling data from the investigations of Lloyd-Jones (25), Preston (41), and Suski (50). The records were amassed between 1930 and 1938, Preston’s at language and church schools in San Francisco, and those of Suski and Lloyd-Jones at public and private schools in Los Angeles. All occupational groups are represented, “from unskilled laborers to business men, manufacturers, literary and professional people.”

Mexican children: This sample of Mexican children was obtained in the schools of Los Angeles during the years 1936-38 (25). Compared with the

⁸On the magnitude of secular variation in children 6 to 10 years of age, see Keyfitz (23), Meredith (28, 29), Meredith and Meredith (33).

⁹Fingoes, Pundos, Sesuto, Xosas, and Zulus.

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Mexican sample previously described, it probably a) represents greater heterogeneity from the standpoint of recent lineage and b) typifies a somewhat higher socioeconomic level. *North American White children of low socioeconomic status*: The data used in calculating these means were accumulated over the period 1932-45 on children attending seven schools in the "poorest districts" of Minneapolis, Minnesota (54), and Ottawa, Canada (19). *Navaho Indian children*: These means are based upon measurements collected between 1932 and 1934 at reservation schools in New Mexico and Arizona. "Care was taken to select those children who were relatively pure Navaho, e.g., those who were known to have any White blood were rejected" (46, p. 115).

North American White children of all socioeconomic groups: Three large series of measurements on "the general run of White American-born boys and girls" were pooled. One series was amassed during 1936-38 in the elementary schools of Los Angeles (25), another during 1939 in the elementary schools of Toronto (23), and the third during 1937-39 "in public and private schools, on playgrounds, in camps, and in clubs" scattered over "16 States and the District of Columbia" (38, pp. 2-3). *American Negro children*: These data were obtained at Los Angeles schools as part of a 1936-38 "School Health Aid Project sponsored by the Los Angeles Board of Education" (25, p. 83). *North American White children of the professional and managerial classes*: For stature and weight, data were utilized from studies by Hopkins (19), Simmons (45) and Weisman (54). The stature materials were combined with data from Stuart and Meredith (49) and the weight materials with data from Meredith (29, p. 32). In the case of the studies by Hopkins and Weisman, the records were accumulated at seven schools in "better-class residential districts" of Ottawa and Minneapolis. The records of Simmons were on Cleveland children from homes "above-average both economically and educationally"; those of Meredith and of Stuart and Meredith on Iowa City children "predominately from the professional and managerial classes."

Given 120 stature and weight means arranged by table for measurement, by row for ethno-socioeconomic group, and by column for age, a large number in intercomparisons can be made. Stated differently, it is possible to extract from Tables 3 and 4 an extensive series of comparative findings. The following have been selected as illustrative:

1. Throughout late childhood, Okinawans are the shortest of the thirteen ethno-socioeconomic groups aligned in Table 3. Specific differences between the Okinawa means and the means for other groups range from 5.1 cm. to 15.3 cm. at 6 years of age, from 4.7 cm. to 15.2 cm. at 8 years of age, and from 4.5 cm. to 16.7 cm. at 10 years of age. The minimum and maximum differences are 4.4 cm. (1.7 in.) and 16.7 cm. (6.6 in.), the former separating the means at age 9 for Okinawans and Mexicans (Texas and Mexico data), and the latter the means at age 10 for Okinawans and North American Whites representing the professional and managerial

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classes. Statistically, all of the stature differences from comparison of Okinawa children with children of the other groups are reliable.

2. In body weight, Okinawans are significantly lighter than any of the groups with which they are aligned over the age period 6 to 8 years and significantly lighter than nine of the groups at all ages from 6 to 10 years. Actual differences in the means for ages 6, 7 and 8 lie between 1.0 kg. (2.2 lb.) and 5.9 kg. (13.0 lb.)—the smaller figure holding for the age 8 means for Okinawans and South African Bantu, the larger figure for the age 8 means for Okinawans and North American Whites of the business and professional groups. At ages 9 and 10, the differences between Okinawans and South African Bantu lack statistical significance; the differences between Okinawans and American Chinese, also between Okinawans and French, are of doubtful significance; while in the remaining eighteen instances where statistical dependability is tenable, the means differ by amounts varying from 1.1 kg. (2.5 lb.) to 7.9 kg. (17.5 lb.).

3. Okinawa children 6 to 10 years of age are much smaller in body size than North American White children.¹⁰ Compared with White children sampled without reference to socioeconomic status, they are shorter by an average of 13.5 cm. (5.3 in.) and lighter by an average of 5.0 kg. (11.0 lb.).¹¹ Taking account of separate segments of the North American socioeconomic continuum, Okinawans are smaller than White children of the laboring classes by 11.2 cm. (4.4 in.) for stature and 3.5 kg. (7.7 lb.) for weight, while they are smaller than White children of the professional classes by 15.7 cm. (6.2 in.) and 6.1 kg. (13.4 lb.) for stature and weight respectively.

At age 10, North American White children of the laboring classes are more than 9 per cent taller and over 16 per cent heavier than Okinawa children. Corresponding percentages, substituting North American Whites of all socioeconomic groups, are 11 and 24 respectively. Matched against the age 10 stature and weight means for Okinawans, North American White children of the professional classes are equally as tall by age 7 years and as heavy by age 7.5 years.

4. In relation to United States Navaho and Pueblo Indian children, the children of Okinawa are markedly smaller than the former and appreciably smaller than the latter. This is clearly shown by the average differences

¹⁰Attention is called to the fact that the ancestry of North American White children is predominately North European. This weighting carries implications for body size, *e.g.*, there are known differences in stature between North American White children whose ancestors came from northern and southern Europe. Samples of 400 boys of "North European" descent and 300 boys of "Italian" descent (9)—the two samples being matched for time (1922-28), place (vicinity of Boston), socioeconomic status (70 per cent of fathers semiskilled, 30 per cent unskilled), and age subgrouping (7, 8, 9 & 10 years)—showed the former to be taller than the latter by 3.5 cm. (1.4 in.). See also references 26 and 27.

¹¹Each of these average values is the mean of the differences between the two groups at successive annual ages from 6 to 10, inclusive.

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for the age period 6 to 10 years: Pueblo children exceed Okinawa children in stature by 6.5 cm. (2.6 in.) and weight by 1.5 kg. (3.3 lb.), while Navaho children exceed Okinawa children by 12.6 cm. (5.0 in.) in stature and 3.2 kg. (7.0 lb.) in weight.

At age 10, Okinawa children are shorter than Pueblo and Navaho children by 5 per cent and 9 per cent respectively; they are lighter than Pueblo and Navaho children by 6 per cent and 12 per cent respectively. Matched against 10-year-old Okinawans, Navaho children are as tall at 7.5 years and as heavy shortly after 8.5 years; Pueblo children are as tall prior to 9 years and as heavy by 9.5 years.

5. The overall body size of children of Mexican ancestry is greater than that of Okinawa children. In the case of children of Mexican ancestry living in Mexico and Texas, there is an average difference over the years 6 to 10 of 5.1 cm. (2.0 in.) for stature and 2.3 kg. (5.1 lb.) for weight. Parallel values contrasting Okinawa children with "Mexican" children residing in California are 10.7 cm. (4.2 in.) and 4.3 kg. (9.4 lb.). It will be seen that there are large differences between the two Mexican samples, 5.6 cm. (2.2 in.) in stature and 2.0 kg. (4.3 lb.) in weight.

Okinawa children age 10 are more than 4 per cent shorter and approximately 10 per cent lighter than 10-year-old Mexican children of Texas and Mexico; they are matched by these children in stature at age 9 years and in weight shortly after 9 years. Correspondingly, 10-year-old Okinawans are over 8 per cent shorter and about 17 per cent lighter than like age Mexicans of California; they are matched by this group for stature before 8 years and for weight soon after 8 years.

6. During the age interval 6 to 10 years, Okinawa children are shorter than United States children of Mongoloid stocks (*i.e.*, American Chinese and Japanese) and lighter than United States children of Japanese lineage. The average stature and weight differences between Okinawans and American Japanese are 8.0 cm. (3.1 in.) and 2.9 kg. (6.3 lb.), while the average stature difference between Okinawans and American Chinese is 6.8 cm. (2.7 in.). Weight means on American Chinese children exceed those on Okinawa children by 1.6 kg. at 6 years, 1.1 kg. at 7 and 8 years, 0.6 kg. at 9 years, and 0.8 kg. at 10 years. A gradual convergence of the two weight trends is indicated: this was suggested earlier when statistical estimates showed that weight differences between the two groups were significant at ages 6 to 8, but of doubtful significance at ages 9 and 10.¹²

7. Compared with Okinawa children, South African Bantu children are significantly heavier at 7 and 8 years of age and significantly taller at all

¹²While discussing North American children of Mongoloid lineage, it is pertinent to cite a report by Hrdlicka (20) for Eskimo children of the Kuskokwin region, Alaska, measured in the period 1928-31. Over the age interval 6 to 10 years, means on these children ($N = 97$) surpass those from Tables 3 and 4 on Okinawa children by 8.0 cm. (3.1 in.) in stature and 3.5 kg. (7.7 lb.) in weight.

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ages from 7 to 10 inclusive. In both measurements, the two groups tend to become more alike with age. Differences between the stature means decrease from 7.4 cm. (2.9 in.) at 7 years to 4.5 cm. (1.8 in.) at 10 years. The weight means differ by 1.2 kg. and 1.0 kg. at 7 and 8 years respectively, and are practically identical at ages 9 and 10 years.

As indicated earlier, the comparative findings itemized in the text of this paper are no more than illustrations of the many accessible to the reader in Tables 1 to 4. It is anticipated that these tables will constitute a frequently used factual source on racial differences at birth and during the childhood years.

SUMMARY

This paper pertains to the body size of children in the first decade of postnatal life. It brings together central tendency materials from studies on Okinawans; South African Bantu-speaking Negroes; North American Negroes; American Chinese and Japanese residents of California; Alaskan Eskimos; Mexicans living in California, Texas and Mexico; Navaho and Pueblo Indians of New Mexico and Arizona; European Whites living in Marseilles, France; and North American Whites of the upper, middle, and lower socioeconomic groups.

Analyses are made at birth, at 3 years of age, and at consecutive annual ages from 6 years to 10 years. The aspects of body size dealt with are stature and weight throughout, and head circumference at birth only. Methodology encompasses adjusting for differences in anthropometric technique, interpolating to attain age comparability, calculating composite means from multiple samples, and testing group dissimilarities for statistical significance. Comparative findings are drawn with particular reference to Okinawa children in relation to children of the other ethno-socioeconomic groups.

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A STUDY OF THE USES OF TOYS IN A HOSPITAL

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This is the report of a study of the use of toys which was carried on at the New York Infirmary, 321 East 15th Street, New York City.¹

REASON FOR THE STUDY

The purpose of the study was to discover what uses toys can serve in a hospital and to gather information and suggestions through observation of their use which might be significant in the further design and manufacture of them. It was thought that such information would have significance for educators, parents, and others interested in children as well as for doctors and nurses and for the toy manufacturers.

By virtue of the fact that this study covers an area that has had limited exploration, this paper will deviate here and there from the conventional report of research. By reason of the exploratory character of the study, the differences between methods, on the one hand, and findings, on the other, are not always sharply defined, since methods had to be adapted and improved as findings emerged.

A preliminary inquiry revealed a variety of practices relative to the provision of toys for hospital use. In some hospitals, most of the toys available to the children are those which they themselves bring from home and those which friends and relatives bring in. Such toys are largely used by the child to whom they belong except when he may wish to share them with another child. In some hospitals, volunteers collect and bring in toys and the ones thus provided are for general use. They are often given by local merchants, or contributed by interested organizations or individuals. This is apt to be a diversified collection. A few hospitals set aside funds for the purchase of carefully selected toys. A few provide a more or less well equipped playroom for ambulatory patients. A few have set up a nursery school or play group usually in the out-patient department.

In this study it was proposed to bring into the hospital toys selected with a view to the hospital needs, to observe their use as an integral part of the

¹This study was conducted under the auspices of the American Toy Institute, the Research Division of the Toy Manufacturers of U.S.A. at the suggestion and with the counsel of the Institute's Advisory Committee, consisting of Mr. Lawrence K. Frank, Dr. Arthur T. Jersild, and Mrs. Eloise Parker. Opportunity to work in the New York Infirmary was made possible by Dr. Ruth Bakwin, Director of Pediatrics. Mrs. Eloise Parker, Occupational Therapist, at the direction of Dr. Bakwin made the practical arrangements for the observers while they were at the Infirmary. A number of the persons who participated as observers were students associated with Dr. Arthur T. Jersild at Teachers College, Columbia University. Dr. Jersild also advised in connection with the reporting of the study.

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day's activities, and to evaluate their usefulness from the standpoint of what they contributed to the comfort, well-being, routine care and cure of the patients. This was found to vary somewhat from the usual approach.

It seemed reasonably certain that toys would be welcomed and used by the children in a hospital, as elsewhere, since play is a natural activity of children of all ages and toys are the tools of play. Under normal conditions a child tries out his developing abilities by means of toys; through their use he expresses his feelings and his growing understandings; with them he not only carries out ideas he already has but he also develops new ideas. In the process he gets a great amount of enjoyment and fun. In the case of a hospitalized child it is likely that toys not only have these same values but that they may have them to an even greater extent than under normal conditions, bringing besides reassurance and comfort as tokens of affection and good will.

To what extent toys might also help in connection with hospital routine and aid the work of doctors and nurses in accomplishing the purpose of the child's hospitalization was an open question. It was, however, surmised that they might be useful in this connection since the children going into a hospital take with them their everyday interests, desires, and needs, even though a new situation is created by the hospitalization. It was thought that the toys might also help in meeting the new needs thus created.

TIME COVERED

The study covered a period of approximately four and a half months. During the two and a half months preceding, a preliminary exploratory study had been carried on and observations made during that period are also included in this report.

CONDITIONS FOR THE STUDY

The study was carried on under the conditions of the regular hospital routine. It was recognized, at the beginning, that no special conditions should be set up for the study. Observations could not be allowed to interfere with, nor to hinder the work of, the doctors and nurses, for the children were there for care and treatment, and it was understood that this was the matter of first importance.

Further, it was recognized that the already heavy duties of the nurses must not be added to. It was understood that the nurses could not be called upon to give any special attention to the study itself since their duties were entirely toward the children. However, since some instruction on the value of toys is commonly included in nurses' training, it was to be expected that they would use the toys in their care of the children, and it was recognized that this would be a valuable source for observations.

As would be expected there were already some toys in the hospital with provisions for their storage when not in use. The addition of a considerable

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number of toys for the study meant increasing this storage space, which was done even though the hospital was crowded and space at a premium. There was some play space in the center of the ward, since beds were placed with the heads to the wall. In this space there was a small table and low chairs where children could sit to play leaving some floor space where push-pull toys could be used. A bed stand at the head of each bed offered a place where a child in bed could lay small toys. The hospital was not equipped with bed tables, but trays were available on which a child in bed could play with his toys. These arrangements would be duplicated in a large majority of hospitals, and the findings are accordingly of more significance than if conditions had been more unusual.

THE HOSPITAL SET-UP

The New York Infirmary, one of the oldest hospitals in New York City, the main building having been erected in 1857, is unique in always having been entirely staffed by women and operated largely for women and children patients. It has a pediatric ward and children's clinics. Arrangements were made for observations to be made in both the Pediatric ward and in the Child Guidance and Allergy Clinics.

The Pediatric ward includes one general ward with 13 beds, one observation and isolation ward with 13 beds and outdoor roof space which is used when weather permits.

The Infirmary cares for practically all types of cases of children up to 13 years in the space above described. The children, during the period of the study, ranged from three months through 13 years.

The Child Guidance and Allergy Clinics in which observations were made are situated on the first floor. The children in the clinics range in age from 2 years to 13 years. The children coming to the clinics are accompanied by a parent or other adult. The children usually wait at one side of the waiting room to see the doctor, the parents waiting for them on the other side of the room. The room is equipped with benches and the children could play with the toys on these, or could use the aisles or the space in the front of the room between the front benches and the offices for push-pull types of toys.

THE CHILDREN AND THEIR CIRCUMSTANCES

As would be expected, the children who were in the hospital while the study was in progress presented a variety of conditions, including children waiting for or recovering from tonsillectomies or other operations; children with ear, nose, or throat difficulties; rheumatic fever patients; cardiac cases; children with pneumonia; children with arthritic conditions; children with cerebral palsy; children under observation awaiting diagnosis; children in casts for one condition or another, etc.

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Children waiting for tonsillectomy or other operations sometimes appear anxious, perhaps awed by the strangeness of the place; sometimes they seemed disturbed by the necessary preliminaries for the operations; again they were apparently much interested in them. Children with ear, nose, throat or other acute difficulty appeared to be very uncomfortable for a short time and then progressively and quickly seemed to feel more and more comfortable with corresponding increase in interest in activities around them. Children in casts, naturally, varied greatly in the range of their activity depending upon the extent of their immobilization and the nature of their difficulty. There was, of course, great variation in the activity of all of the children. For some, it was necessary that they lie down most of the time. Of these, some might be too sick to be interested in play. Others might feel like playing a little. Some were able to sit up in bed to play. Some were in wheel chairs and thus were able to move from place to place and often did this to find companionship in play. Others were ambulatory and so able to move around freely.

As would be the case in any hospital, there were periods which inevitably were hard for the children. There were the periods of admission when everything was strange and for some children probably frightening even though everything possible was done to make it easy for them. There were the periods following the departure of parents either upon admission or after regular visits which, for some children, were sure to be lonely. There were the periods before an operation which must have been anxious times for some. And there were the periods of idleness and consequent boredom which could hardly fail to come during long hospitalization.

EXTENT OF OBSERVATIONS

During the four and a half months covered by the study there were 153 different children observed in the pediatric ward and clinics. Of these 126 were in the ward and 27 in the clinic. With a total of 26 beds this indicates a high turnover.

From the standpoint of the study this means that many times when the observer appeared there would be only a few children present who had been there at the previous observation. Often a given child would be seen by the observer only once. This meant that the observer saw the toys used by many different children.

The observations, therefore, could not follow a given child's use of the toy on consecutive days over a period of time, but of necessity rather centered on the toys themselves and on the various uses made of each one during each observation period with recording of the use of the toy, the ages of the different children using it, the degree of mobility of each child, any apparent physical condition explaining the use made of the toy, the part played by the adult, etc.

A few children were present continuously for a period of weeks and this gave the only opportunity to study the progressive use of toys by the same

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child. These included an infant of seven months who had one leg in a cast when the study began and who stayed three and a half months; another infant of three months at the beginning of the study, under observation; four children with cerebral palsy, ages six, three and one half, and three years (2); and a girl of fourteen years with rheumatic fever.

As would be expected, the hospital records of the children were not available to the student observer, so they could record only such facts about the child as were told to them or as were plainly obvious to them. The head nurse always gave the observer such precautionary information as was needed to protect the child. Later in the study, as the nurses and observers became acquainted, many bits of information were given which were of great help in interpreting observations. Often the Occupational Therapist supplied some information. The name plate hanging on each child's bed gave the name of the child, the age, and the date of entrance.

Of the 27 different children observed in the clinics, some came only a few times, others regularly over a period of weeks. Here, too, there was opportunity to learn little more about a child than could be seen by a casual observer.

HELPFUL ATTITUDES OF DOCTORS AND NURSES

The interest and encouragement of the doctors, the director of the clinics, and the nurses, and their willingness to allow the observers as much freedom as possible was of the greatest help. Doctors often stopped to play with a child for a few moments and were very generous in the time they, themselves, gave in observing the children's use of toys and in passing on their comments. The Director of the Dispensary and Assistant Director of Nursing Service made observations in the Clinic and on her own time wrote up her comments on the use of the toys. The Head Pediatric Nurse was a keen observer, kept notes of her observations, and wrote a summary report at the end of the study. These observations and comments by members of the Staff were of the greatest help in the study, being made as they were, by those most familiar with the situation.

NECESSITY OF GEARING OBSERVATIONS TO HOSPITAL ROUTINE

As time passed, the student observers gained increasing understanding of the hospital routines and regulations and this made it progressively possible for them to make their observations without causing difficulties for doctors and nurses. This understanding by observers is of the utmost importance in making a hospital study and upon it often hinges the effectiveness of the study. For example, the observers must remember, respect and be ready to carry out the hospital requirements, such as always wearing a washable smock. They must know and respect the fact that when doctors are making their rounds in the ward full attention must be given to that and an observer must keep out of the way and record silently and unobtrusively.

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The observer must also know and respect the fact that given things happen at given times in the ward—such as baths, feedings, naps, etc., and that these times must be respected. There is likely to be no opportunity for the observer to question, only to observe and record. These details are of great importance in making a study of the use of toys in a hospital, for their use must be fitted to the hospital routine and not the routine to the toys.

In the present study, no request was made for anything in the hospital routine to be changed, since one purpose of the study was to discover whether or not toys have a usefulness in carrying out that routine and if so, what.

SELECTION OF TOYS FOR THE STUDY

The initial selection of toys to be used in the study was made on the basis of what is commonly known about the interests of children of different ages in general, and the interests of ill and convalescent children in particular.

At first, toys were selected from each of the following major groups—manipulative toys, construction toys, toys for active play (push-pull type), toys for imaginative play, games, and puzzles. It was thought best to begin with a few toys of several different types rather than with many in order to give variety and at the same time avoid confusion and for the very practical reason that space was not available at first for storing many.

Care was taken to include in the initial selection, toys which it was thought would be of interest to the different age groups, bearing in mind the fact that ill and convalescent children probably would prefer things that could be handled more easily than those with which they would ordinarily play. Toys calling for strenuous physical effort were avoided and for the most part the items selected were toys with which a child could play alone. Since it was known that play on the floor was not looked upon favorably in this hospital this was kept in mind and blocks and similar materials usually used by children on the floor were not at first included. Crayons, paints, clay, were at first omitted since bed tables were not available and it was hard for the children to use these materials without. Since space was limited large toys were not included. It was kept in mind that all toys for hospital use must be such as could be sterilized, carbolized, or otherwise kept sanitary, since many different children with many different ailments would be using them. Further, noise-making toys had to be avoided since quiet on the ward was necessary and in the clinic noise and confusion had to be avoided. A considerable variety of toys was provided and this made it possible to get an indication of the types of toys most popular with the children, most useful from the standpoint of doctors and nurses, and most suitable for a hospital set-up.²

²A study which deals more particularly with the suitability of toys of various size, structure, and architecture for hospitalized patients is being prepared by Miss Claudia Gips.

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A second selection of toys was made a few weeks after the beginning of the study. This selection filled in some of the gaps obvious in the first selection and included dolls, much more equipment for housekeeping play, paints and clay, more games, and some additional manipulative toys, since so many of the children were under four years and also since manipulative toys are of special usefulness for cerebral palsy cases.

A further addition which was made just before this report was written brought in more puzzles and games, more construction toys, more dolls, coloring books, picture books, miniature toys and dolls and doll furniture, sewing sets, weaving mats, etc. Most of these toys had just arrived when this report was being written so observations of their use and comments on them will be left for a later report.

Since from the beginning the children showed great interest in housekeeping equipment it was apparent that much use would be made of this if a play corner could be set off by itself where such equipment could be used by ambulatory patients and while this report was being written this has been done. In continuing the study, it will be of interest to add different types of toys for housekeeping play in order to discover what purposes each will serve and which best fit the hospital needs.

PRESENTATION OF THE TOYS

Sometimes the toys were brought into the ward by the Occupational Therapist, sometimes they were offered by the nurses, and sometimes by the observers as they became accustomed to the hospital routine.

In distributing toys to the children, the Occupational Therapist always kept in mind the child's diagnosis and any special orders left by the doctor; the child's strength and span of endurance; his general ability, physically and mentally, and his age and particular interest.

There was no prescribed way of offering a toy. Neither was there any set rotation of toys nor any time limit on their use. Sometimes a toy which the observer thought would interest a child was taken to him, only to have him turn away from it. Perhaps another one offered would be seized upon at once. Sometimes two or three toys would be taken to a bed and a choice offered. As children grew familiar with the toys, one or another would often ask for some favorite one. Sometimes several toys would be placed on the play table in the center of the room, or on the table on the roof if the children were there, and ambulatory children could make their own choices. Sometimes a child would be left to play with the toy alone, again the adult might play with him for a time. This might be the doctor, or the Occupational Therapist, or the nurse, or the observer, or one of the volunteers who were present from time to time.

At first the toys when not in use were kept in a cupboard just outside the ward. Later, in order that they might be more easily available to the children, a toy chest on the ward was provided where the children could get them as they wanted them.

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NATURE OF THE RECORDS

The observers took notes on the use made of each toy, the age of the child using it, whether he was in bed or out, any information about his condition that was available, the child's comments, if any, about the toy, whether he played alone or with others, etc., adding such interpretative comments as the observer thought might later be useful in understanding the play. There was no set form for taking notes.

There was some attempt at first to keep a record of the length of time a toy was used by a given child but this was not very successful. Often it still would be in use when the observer left, or it might be used a little while, laid down, taken up by another child, laid down and again taken up by the first child. At any rate, the length of time a toy was used seemed not nearly so significant as what was done with it.

Since the students making the study could be at the hospital for only limited periods of time, the Occupational Therapist kept notes of her observations; the Head Nurse, as mentioned before, did likewise; and all of these observations together with comments of doctors and others and observations of the writer have been taken into account in this report of the findings. With the experience gained through this study, later studies may well be made with more uniformity and with a more systematic series of observations.

FINDINGS

The findings of the study are varied and suggestive. They cannot, however, as will be observed from the above account, be set forth in definitive quantitative tables. It has not been possible to draw up frequency tables to show the incidence of this or that use of a toy, nor has it been possible to chart the time a given toy was used. Rather, the findings have had to be set forth in a series of summary statements showing the uses of the toys as noted by all or most of the observers. These statements, because of the rapid turnover of the children mentioned earlier, represent observations of many different children, of varying ages and with many different types of ailments. The only exceptions are the observations of children with cerebral palsy where the statements made are based on observation of four children each with a different type of difficulty, and the observations of three other children present for three and a half months at the longest.

FINDINGS RELATED TO USE OF TOYS IN THE HOSPITAL

Aid in Tiding Over Critical Periods

The observations showed that frequently a toy seemed to be useful in tiding over some critical moment. Again and again it was noted by observers that the crying which often occurred as the parent departed after admission tended to diminish when some interesting toy was offered. Even though the toy might be refused at the moment and the crying continue,

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usually it was not long before attention turned to the toy and when that happened the crying tended to die away very shortly. The same thing often happened when parents left after their regular visits. Again and again the records showed toys being given to children to while away the period of waiting before an operation. Presumably, in play with the toys, some of the anxiety concerning the operation, if there were such anxiety, was lessened. Frequently, it was noted, a toy was offered coincident with the approach of the doctor for dressing and, in the opinion of the observers, may have helped in lessening any resistance there might have been to the necessity of the moment.

Even the cherished toys which children bring with them from home, the observer pointed out, do not seem to serve the same purpose as the toys they meet at the hospital—new to them perhaps—and compelling enough in their novelty to help them forget the troubles of the moment.

Aid to Routine

The observations further showed that toys were frequently used in connection with carrying out some necessary routine, and in the opinion of the observers, seemed to be of some assistance. Often, at nap time a child would ask for some favorite toy and would play quietly with it until sleep came, perhaps still holding it while sleeping. Sometimes, a child who, instead of resting, wanted to visit with the child next to him at nap time would be given a toy and would turn attention to it, soon getting quiet enough to drop off to sleep. The records show one child who often wanted the doll to have a bath when she had hers and who seemed greatly delighted when the nurse entered into the fun with her. Conceivably this might be an aid in getting a child's cooperation in this necessary routine. There were other children who wanted the doll with which they had been playing to sit beside them as they ate, and who were very pleased at the nurses' willingness for the meal to be shared. In the opinion of the observers this might be an aid with children who, for one reason or another, were not particularly interested in meal time.

Relief from Boredom

The records show numberless instances where toys served to turn what might have been periods of boredom into periods of happy activity. For example, Sharon was a seven-months-old baby with one leg in a cast to her hip. The nurses played with her but often there were times when they had to be busy with other things. One day, as a nurse who had been playing with her left her to attend to other duties, Sharon began sucking her thumb. The nurse brought a toy with dangling balls and rings suspended from a heavy tape which fastened across the crib and put it on the crib just in front of Sharon. She watched as it was being fastened and as the nurse stepped back, Sharon reached out with her free hand and touched one of the rings. Evidently pleased with the feel of it, out came the thumb,

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and both hands were used as she touched rings and balls, often trying to get one into her mouth. For forty-five minutes she played using both hands and stopped only when lunch time arrived. During the remaining six weeks of her stay this toy remained of absorbing interest. As she began to sit up she often pulled herself up by it and as she sat more and more steadily she played with it, sometimes pulling on the balls and rings, again swinging them back and forth, often putting her hands through the rings. Other toys were added from time to time and Sharon's days were busy, happy ones, as she played first with one and then with another. Presumably the interest in the toys lessened the thumb sucking with which she might have occupied herself.

An eleven-month-old baby in the play pen on the roof cooed and gurgled, and gurgled and chuckled as he played for more than thirty minutes with some small rubber blocks. He felt them, he chewed on them, he hit them together as he held one in each hand, and then, too sleepy to play longer, he toppled over sound asleep still clutching a block in each hand. There he slept with the blocks all around him and one, evidently bouncing when he hit it as he toppled over, lying in the middle of his back.

Effect on Morale

The contribution of high morale to accomplishing the purpose of hospitalization is well known, and is often pointed out as being particularly important with children under long hospitalization or those for whom being away from home is difficult. Toys are often mentioned as being useful in maintaining children's morale under any kind of trying or unusual or difficult condition and the observations showed many instances where they seemed to serve this purpose in the hospital.

One such instance is of a 14-year-old rheumatic fever patient who had been hospitalized for a period of several months. She became progressively more interested in first one kind of material and then another, began to show interest in the younger children's use of toys, and gradually came to welcome, and then to ask for a game or puzzle or piece of weaving or sewing material.

Substitute for Mischief

The records contain frequent mention of the use of toys in reducing or preventing the problem of discipline which can be disrupting on a hospital ward or in a clinic. Both the Head Nurse and the Director of the Clinic made special mention of this. Records show instances when the offer of a toy brought an impending quarrel to an end. Children busy with toys in which they were interested had something better to do than chasing each other around the ward. Being busy with a toy helped to reduce the aimless yelling at each other from one bed to another, or if yelling did begin, the offer of toy telephone, for example, turned attention to more constructive play.

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Revelment and Expression of Feelings

The revelment and expression of the child's inner thought and feelings through the play which was observed especially in the clinic was mentioned often by the observers. It should be understood that in commenting on what they recorded of the play observed, the observers were making their own interpretations which, under the circumstances, were of necessity largely speculative. They had no way of knowing the background of the children observed, nor did they have any information about the reason for the child's being brought to the clinic. Of course, no one but the clinic workers talked with the parents, and observers could not expect information thus secured to be passed on to them. Therefore, they observed the children and parents as they came, observed and recorded the children's use of the toys, and made such comments as occurred to them, concerning the possible significance of the play which they observed. Being familiar with children and their play and knowing that a child's inner thoughts and feelings are often clearly revealed in his play wherever he may be, it was entirely natural and to be expected that the observers would feel that, in the hospital too, the play was similarly revealing.

The records show that the play with miniature-life toys, house furnishings and dolls, was greatly varied and, in the opinion of the observers, significantly revealing. Sometimes a child would spend considerable time arranging and rearranging the pieces of furniture commenting as he did so. Again, scenes of violent family friction were played out in realistic detail. In one case, the family went on an outing and two of the children were lost with ensuing excitement. Another time, there was a fire and all the furniture had to be taken out of the house with much comment alternated with the subdued screeching of fire sirens. In one instance, the mother in the family was made to put all of the other members outside with the door closed behind them. Scenes of eviction were played out frequently.

The records show that the toy telephone brought forth many different kinds of conversations. Sometimes a child called up his mother and asked her to hurry and come for him. Again, one called a friend and carried on a long conversation telling all sorts of family doings and bits of news. Again, one called a member of the family and gave a minute account of all that he (the child) had been doing for several days. Another called someone and told in no uncertain terms what he thought of him. One called a child a few feet away also playing with a toy telephone and when this child said "Hello" the one calling shouted "Shut up" and slammed down the receiver.

The observers, in their comments, mentioned the usefulness which they saw in having toys available during the necessary waiting periods at a clinic, since the play for which they would offer the opportunity could be expected to furnish significant clues to the child's thinking and feeling about the difficulty which may have been the cause of his being brought

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to the clinic. The records mention, also, that waiting mothers seemed to be interested in the play not only of their own child but of other children. One mother was heard to comment to another mother that she did not know her child could do so well as he put some puzzles together quickly and skillfully. Another seemed to get great amusement from hearing her little girl talking over the toy telephone and was heard to say to another mother a few seats away "Sounds just like me when I scold the kids." In commenting on these observations in connection with the children's play, the observers mentioned the possible usefulness of the toys and the consequent play in revealing to the parents themselves some of their children's feelings and thoughts. No doubt toys are used in this way by the workers in their conferences with children and parents, though the observers had no way of knowing and saw only the play in the waiting room which served the main purpose of keeping the children occupied.

Use of Toys by Cerebral Palsy Cases

The usefulness of toys in meeting the special needs of cerebral palsy cases was frequently mentioned. The toy telephone, for example, encouraged conversation of a kind useful for the child with speech difficulty. The manipulative toys, such as one which permitted colored wooden disks to be slipped over a metal loop fastened into a firm base offered exercises for hand muscles of a sort that seemed to be needed by the child whose hands do not function normally. Toys that could be used on the table as a child stood beside it helped to keep on his feet the child whose leg muscles were unsteady. From the observations it was obvious that only the very barest beginning has been made in discovering the usefulness of toys as an aid to treatment of cerebral palsy cases.

Good Fun

The fun and happiness which children in the hospital, as elsewhere get out of toys is one of their most observable values and was mentioned again and again by the observers. The records cite many instances of children playing with apparent enjoyment for long periods of time. Frequent instances are recounted of nurses joining in with the child's play to the child's evident satisfaction. Obviously this was considered important by the hospital as indicated by the willingness to have their supply of toys supplemented with those brought in for the study and the willingness to have the study carried on.

FINDINGS RELATIVE TO THE SELECTION OF TOYS FOR HOSPITAL USE

Cleaning

Included in the observers' records was frequent mention of seeing the nurses cleaning the toys either by sterilizing, rubbing with alcohol, scrubbing, or airing in the sun. This brought to the observers' attention the fact

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that the toys selected for hospital use must be such as lend themselves easily to such cleaning, and further that they should be able to withstand the often-repeated cleanings necessitated by the fact that they are used by many different children with many different ailments.

Durability

During their period of observation the observers evidently became increasingly aware, as evidenced in its frequent mention in their notes, that toys for hospital use need to be sturdy and durable since they are in use a great deal of the time and are used by many different children of different ages.

Packaging

Mention was made of the need for sturdy durability of the boxes in which toys were packaged. Children playing with a toy in bed, particularly, records showed, used the box in which it came, sometimes as a surface on which to play, sometimes as part of the play itself. The greater the durability of the box, too, the easier the care of the toy when not in use. Boxes in which toys can be easily repacked were mentioned as desirable not only to provide care for the toy, but to encourage the child's putting the toy away.

Ease of Use

The observers frequently mentioned that the children seemed to want quick results in their play and that the toys which seemed to catch and hold their interest were those that were easy to use, with minimum of small pieces to get lost. Generally speaking, they seemed to want toys a little simpler than their age would have indicated. This is easily understandable, since they were below par physically and so welcomed toys that called for less than their usual effort. This suggests selecting toys that are easy to use and ones with which quick results are possible.

Individual Play

Observations indicate that a relatively large amount of the play observed was individual, since much of it took place in bed. Even when children were ambulatory the play might still be largely individual, perhaps because less effort was required, perhaps because the children were not well enough acquainted to join in play together, perhaps because the age of the child made him unready for play with others. In any case, this suggests selecting, for the most part, toys with which a child can play alone with a few included which two or three might use together. Some of the toys which could be used by a child playing alone were also used equally well by two or three, for example, dolls, housekeeping toys, puzzles.

Interest Appeal

Just what made for interest appeal was, perhaps, a matter of opinion and speculation and a point requiring more study. In some instances, observers

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thought it was color and sound, particularly with the younger children. In others they mentioned the novelty and unfamiliarity of the toy to the child, but again it was the familiar which seemed to make a toy welcomed. Sometimes, obviously, it was because the toy satisfied the child's interest in manipulation, again it was because the toy lent itself to creative use, to carrying out the child's own idea. Or it might be because of its possible use for dramatic play. Sometimes it seemed to be the idea for play suggested by the nature of the toy that made it welcomed. For example, the container with six milk bottles usually started a milkman on a route from bed to bed forthwith. The drinking-wetting doll immediately suggested play with her as a baby. Tea party dishes suggested setting the table followed with tea party play. Toys with such obviously suggestive possibilities were usually accepted readily. Some others, less obviously suggestive might take a period of play with the adult before interest took hold.

Instructions for Use

The observers often mentioned that when instructions accompanied the toy, the children were very pleased when they could read and follow them with a minimum of adult help. This suggests the desirability of simple, clear, easy-to-follow instructions. Further, mention was made that having instructions on the box lid instead of on a separate paper, was an aid to nurses, reducing the danger of their being lost or destroyed.

GENERAL CONCLUSIONS

Examinations of the records of the observations show that, in the opinion of the observers, the study, though admittedly limited, indicates convincingly:

1. That toys serve such a useful purpose in a pediatric ward and in children's clinics that there is good reason for them to be considered a part of a hospital's standard equipment.
2. That toys are a valuable if not indispensable aid in accomplishing the purpose of the child's hospitalization and of his attendance at the clinic.
3. That toys are of practical use in aiding the nurse in getting her work done, since they help to keep the children happily occupied, reduce the problems of discipline, and make it easier for her to carry out the doctor's orders for keeping certain children in bed, others quiet, etc.
4. That toys have a practical usefulness in meeting the needs of special cases such as children with cerebral palsy, poliomyelitis, rheumatic fever, etc.
5. That toys serve a constructive purpose in the clinic waiting room, through providing the opportunity for interesting activity, thus reducing aimless running around and giving children something more interesting

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to do than indulging in loud, boisterous play or quarreling among themselves.

6. That toys for hospital use should be those that can be easily cleaned and can withstand many frequent cleanings; that are simple and easy to use, with few small parts to be lost; that are durable enough to survive active use by many different children, and that lend themselves to individual use.

7. That the toys most readily accepted and used for the longest times are those that are simple and can be used with a minimum amount of concentration or effort; that are in themselves suggestive of some play activity, and that can be used in a variety of ways.

8. That attractive and durable packaging contributes greatly to the desirability of a toy for hospital use.

SUGGESTIONS FOR FURTHER STUDY

The present study, essentially an exploratory one, offers findings which show leads for further, more detailed studies, covering longer periods of time and a larger number of cases. Some of the further studies clearly implied in the findings, and which it is to be hoped will be undertaken, are suggested below:

1. What general uses can toys serve in a hospital?

This would be a continuation of the present study to discover more about the greatly varied general uses toys can serve in the hospital. In a further study it would be helpful to offer each of the toys to children of different ages observing more fully than has yet been done the differences in their use by children at different age levels.

2. What use do toys serve in keeping up patient morale?

Attention would be centered on patient morale, instances where it is likely to be low and use of toys can serve in keeping it up.

3. What toys are specifically indicated for children with special ailments, such as cerebral palsy, cardiac difficulties, arthritic conditions, etc.?

4. From the standpoint of doctors and nurses what are the advantages and disadvantages of toys as a part of a hospital's equipment?

This would be taken up from the standpoint of hospital routine and the usefulness of toys in accomplishing the purpose of the hospital.

5. What physical arrangements in the hospital are practical and best provide for the use of toys as a regular part of hospital equipment?

This would be included in hospital planning and would be a study of ways of storing the toys so that they could be used with a minimum demand on the nurse's time in getting them out and putting them away. It

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would include arrangements for the children to use them in bed, arrangements of play space in the ward for ambulatory patients, perhaps planning a playroom, and arrangements for use in the clinic.

6. What units on the use of toys are included in nurse's training courses throughout the United States?

This would be a survey study.

7. What is the common practice in hospitals throughout the United States relative to (a) the provision of toys as a part of hospital equipment (b) the use of toys in the regular hospital routine?

CONCLUDING COMMENTS

The study herewith reported is only a bare beginning. However, it has disclosed possibilities in the use of toys in a hospital which, in the judgment of those associated with the study, have significance for the Hospital of Tomorrow, where toys will be considered an essential part of standard equipment. Those associated in this study also believe that further investigative study of the uses of toys in connection with the hospitalization or convalescence of children is much needed and will be very rewarding.

STANDARDS OF VARIATION IN THE ERUPTION OF THE FIRST SIX PERMANENT TEETH

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The establishment of norms and standards for various anthropometric variables pertaining to the teeth of children is still quite incomplete. Among the standards that still are lacking are those relating to the eruption of teeth. Although it can be argued that such standards would not fit perfectly any given child, it is self-evident that exact knowledge of the usual ranges of variation encountered would furnish convenient frames of reference for numerous biometric studies of individual children and groups of children. Such standards would be of value in attempts to interpret various reports which contain references to the clinical emergence of the teeth.

Several studies of rachitic and non-rachitic children have established the fact that at least one deficiency disease is generally accompanied by retardation of dental development. These studies remind the investigator of the necessity of being able to gauge tooth eruption in terms of small fractions of a year, rather than in terms of whole years. Therefore, since the physiologic processes which result in tooth emergence take place at a rapid rate when they do occur, it is imperative that the standards used are even more accurate than those which have to do with certain other growth phenomena, such as increases in body height and weight. A continuation of nutritional studies, as well as the development of broader programs dealing with constitutional types or a variety of pathological conditions, requires the establishment of best possible criteria for evaluating observations made on the teeth.

It became evident early in the course of this bibliographic study that presently available literature did not make the task of proper colligation easy. Not only were many of the best papers dealing with the time of eruption of the permanent teeth published in journals that are difficult of access, but the chief objective of the study made it absolutely necessary to review these papers in great detail. It was obvious that the standards derived would be of value only if they were based upon source material which met certain definite and reasonably exacting requirements.

Selection and standardization of data on the ranges of variation.

There were two main problems to be solved in attempting to summarize existing data on tooth emergence. The first of these had to do with the determination of the shapes of the frequency curves which give the cumulated percentages of erupted teeth at various age levels. The second important task was the selection of reports that could be used for calculating the mean and median ages of eruption of individual classes of teeth.

The first problem could be attacked only by determining what reports furnished figures that could be reduced to graphic form for describing

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chronologic variations in the eruption of individual teeth. The reports selected had to furnish data covering at least one half of the age range during which a particular tooth crown is likely to make its debut into the external environment. The reports utilized for this purpose did not have to contain a definition of the term "eruption." It seemed safe to assume, after comparing several series of graphs representing data on teeth in various stages of eruption (i.e., graphs for teeth that are "just erupting," "in any stage of eruption," "fully erupted," etc.), that the shapes of the curves are not dependent to any appreciable degree upon the investigator's exact criteria of "eruption." This must not be taken to mean that careful studies in the future will not reveal statistical differences in the ranges of variation for different developmental stages of tooth emergence. The present study indicates only that if such differences do exist, they are of relatively small magnitude and of negligible importance in many biometric analyses. Therefore, the data were graphed on the presupposition that the average intervals between various stages of supragingival eruption are of equal magnitude at all age levels in a given group of children.

Lack of standardization of methods of recording and publishing data on eruption made the task of graphing the selected material a tedious process. Some authors, for instance, publish their figures for the right and left teeth separately, without presenting averages for the two sides. Some give the data in terms of the number of teeth observed, without computing any percentages. Some furnish the data for the two sexes separately, while others do not. Very few of the authors summarize their statistical material in a convenient graphic form. Much of the graphic material that is available is difficult of utilization on account of the poor planning or the diminutive size of the published graphs. The facts mentioned above give the reader some concept of the difficulties involved in forming a logically coherent assemblage of existing data on tooth eruption. The amount of work involved in preparing such data for further analysis can be appreciated even better if one remembers that from 21 to 29 separate standardization processings had to be completed for each one of the six permanent teeth discussed in this report.

The reports utilized for determining the frequency curves mentioned above varied in number from 14 for the mandibular first incisor to 18 for the maxillary first incisor. The sources of graphed data are listed in greater detail in Table I.

The problem of chronologic age.

The second main problem had to do with the determination of the chronologic ages of tooth emergence. Before this problem could be attacked successfully, it was necessary to find out what reports dealt with tooth eruption in an unambiguous manner. The difficulties encountered here were threefold.

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In the final computations only those reports could be utilized which contained a reasonably clear indication of the meaning of the term "eruption" as used by the author. This seemingly simple requirement put the reviewer to much inconvenience, as very few of the publications provide the reader

TABLE I

A list of authors whose publications contain data that can be used for determining the cumulated percentages of teeth in any stage of eruption at various age levels.

AUTHOR, with specification of data used	FIRST MOLARS		FIRST INCISORS		SECOND INCISORS	
	Max.	Mand.	Max.	Mand.	Max.	Mand.
Berten (1895)	BG	M ¹	BG	M ¹	BG	BG
Bunting (1909)	M	M	M	M	M	M
Cartwright (1857)	M	M	none ²	none ²	none ²	none ²
Cattell (1928)	BG	BG	BG	BG	BG	BG
Chérot (1898)	M ¹	M ¹	M ¹	M ¹	M ¹	M ¹
Cohen (1928)	BG	BG	BG	BG	BG	BG
Cohen (1936)	M ¹	M ¹	M ¹	M ¹	M ¹	M ¹
Degerböl (1929-32)	insuf.	insuf.	BG	insuf.	BG	BG
Ekman (1938)						
rural children	insuf.	insuf.	BG	insuf.	BG	BG
Helsinki pub. school children	BG	BG	BG	BG	BG	BG
Förberg (1901)	insuf.	insuf.	BG	insuf.	BG	BG
James & Pitts (1912)	M	M	M	M	M	M
King (1940)	M	M	M	M	M	M
Klein, Palmer & Kramer (1937)	BG	BG	BG	BG	BG	BG
Medical Res'ch Council (1925)	none	B	B	none	none	none
Suk (1919)	B	insuf.	B	B	B	B
Unglaube (1924)	BG	M ¹	BG	BG	BG	BG
Wallis (1931)	BG	BG	BG	BG	BG	BG
Wuorinen (1926)	BG	BG	BG	BG	BG	BG
No. of sources of data	15	15	18	14	17	17
No. of graphs:						
Boys	9	7	13	8	12	12
Girls	8	6	11	7	11	11
Mixed groups	6	8	5	6	5	5
Totals	23	21	29	21	28	28

¹Character of data unsuitable for meaningful separation on sex basis.

²Cartwright did not tabulate figures for first and second incisors separately.

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with an easily located definition of the term. In many instances the only clue to be found was in an inconspicuous footnote, or in the discussion at the end of the article. In one or two cases the meaning of the term could be determined only by becoming thoroughly familiar with the contents of the entire article.

The manner of recording age, likewise, had to be carefully determined. To illustrate, some authors mean $6\frac{1}{2}$ years when they write "6 years." Some express this by giving the age period, as "6 to 7 years," while others designate age by recording the midpoints of the periods. The age periods themselves vary in length from one report to another, ranging from 3-month intervals to one-year intervals. The definitions of "eruption" and the manner of furnishing the time data are given in Table II.

TABLE II

*A list of authors whose publications contain information that
can be used for determining the exact location
of eruption curves along the time axis.*

AUTHOR, with specification of data used	DEFINITION OF "ERUPTION"	LENGTH OF AGE INTERVALS (months)	AUTHOR'S DESIG- NATION OF AGE INTERVALS
Bunting	"erupted or erupting"	6	midpoint
Cattell	"broken through the gums"	6	midpoint
Chérot	"apparition dans la bouche"	12	beginning
Cohen, 1928	"when cusps showed"	12	limits and midpoint
Cohen, 1936	not given, but presumably same as above	12	beginning
Degerböl	any stage of eruption, accord- ing to contents of report	3	limits
Ekman	"jeder Zahn, der auch nur zu einem Teil das Zahnfleisch durch- brochen hatte"		
rural children		12	beginning
city children		12	beginning
James & Pitts	"just erupting" and "present"	3	limits
Klein, Palmer & Kramer	"one mm. or more . . . above gum"	12	beginning (6-7 yr. group = 6 $\frac{3}{4}$ yrs.)
Medical Res'ch Council.	"any stage of eruption"	3	midpoint
Sok	"erupted or erupting"	12	beginning
Wallis	"broken through the gums"	12	midpoint
Wuorinen	"gesprengt"	12	beginning

The third difficulty encountered in tackling the problem of chronologic age was that relating to the sex differences in the ages of eruption. Even a cursory survey of published data reveals the existence of much disagreement on this point between various authors. Table I, again, shows that the number of publications containing suitable data on eruption in *both* males and females is relatively small if the selection is confined to statistical material that can be graphed. Therefore, in order to augment the supply of basic data used for computing the average sex differences, the literature was searched for other tabulations which would give the sex differences either directly or indirectly.

Most of this additional material was found in the reports already listed in Table I. Regarding the reference furnished by the Medical Research Council of Great Britain (19), the sex differences were obtained from the tables on teeth "in any stage of eruption," other tables being ignored. But three additional sources of information were located. The data by Gebhart (14) on American-born children of Italian ancestry could be utilized by averaging the values for the right and the left teeth in the two sexes. Similarly, the data by Hellman (15) on Jewish-American boys and girls yielded useful figures when averages were computed from the values on "wealthy" and "poor" children. (Certain details concerning Hellman's material can be obtained only by consulting Gebhart's report.) Finally, an article by Steggerda and Hill (20) furnished carefully compiled statistical material, which could be made available in the same manner as Gebhart's tabulations. Only the data on white children were utilized.

Graphing of available statistical data.

After completing the bibliographic search for usable data and after finishing the preliminary standardization treatment of these data, graphs were constructed for all statistical material that could be reduced successfully to this form. Cumulated percentages of erupted or erupting teeth were represented by the ordinates of the points plotted, while the abscissae represented the time factors involved. When the plotting of points for a series of values for a given tooth was completed, a curve was drawn by the free-hand method in such a way as to summarize as accurately as possible the trend suggested by the points. A trend line fitted by this method naturally "smooths out" all minor irregularities. As shown in Table II, the age intervals varied from three to twelve months in the publications. However, it was not found much more difficult to draw trend lines for points indicating 12-month intervals than for those indicating 3 or 6-month intervals. The freehand method of constructing integral curves of best fit was selected because it was felt that existing statistical data have not permitted the development of mathematical equations which describe the variation in tooth

emergence with absolute accuracy. The author is aware of the use of logistic curves of the form

$$Y = \frac{K}{1 + e^{a+bx}}$$

by certain investigators in Europe and the employment of the normal probability curve by Klein, Palmer and Kramer in the United States. There are no reasons for doubting the claims that the mathematical methods just mentioned furnish theoretical values which correspond surprisingly well with actually recorded values. Nevertheless, it still remains desirable to subject these mathematical approaches to critical evaluation. One of the purposes of the present study is to furnish biometricians with factual data with which various theoretically derived distributions can be compared.

Determination of sex differences.

The first step after graphing available numerical data consisted of finding out whether there were any consistent differences between the shapes of the frequency distribution curves obtained for males and females. This was important on account of the limited number of statistical studies published, especially since the usefulness of the graphs derived for mixed groups depended upon the non-existence of appreciable sex differences in variation. The results of this investigation, which was carried out separately for each one of the six teeth, indicated no noteworthy differences in the shapes of the curves for boys and girls. For this reason it was assumed, later, that the standard deviations for the sexes are approximately the same for a given class of teeth if the number of children examined is sufficiently large.

As stated on page 217, in order to compute the mean sex differences in the ages of tooth emergence, data from two principal sources were employed. The graphed material already described was one of the sources. If an author supplied data on eruption in both boys and girls, it was a simple matter to note the age difference between the points where the two "ogive" curves for a given tooth crossed the 50 per cent line. This (median) level was selected for making the determinations because, according to elementary theorems of probability, it is an established fact that such estimates are most reliable when they are based on values obtained from the middle ranges of distribution. Furthermore, as was pointed out in the preceding paragraph, no allowances had to be made for significant differences between the shapes of the curves for males and females. The second source of data on sex differences was furnished by tabulations which could not be reduced to graphic form. These data, and the data from graphs, were utilized for computing the figures shown in Table III.

TABLE III

Sex differences between ages of emergence of the first six permanent teeth and the variability of figures obtained from different sources.

(The values are given in decimals of a year.)

TOOTH	NUMBER OF SOURCES OF DATA	RANGE OF AGE INTERVALS	MEAN SEX DIFFERENCE ACCORDING TO		
			Tables	Graphs	All Sources, with Standard Error ¹
Max. M-1	16	0.07-0.33	0.19	0.17	0.18 ± 0.05
Mand. M-1	14	0.09-0.50	0.29	0.25	0.27 ± 0.08
Max. I-1	19	0.13-0.40	0.28	0.26	0.27 ± 0.06
Mand. I-1	15	0.16-0.38	0.30	0.26	0.28 ± 0.07
Max. I-2	19	0.38-0.70	0.46	0.48	0.47 ± 0.11
Mand. I-2	19	0.18-0.56	0.38	0.35	0.36 ± 0.08

$$^1S.E._{mean} = \pm (S.D. / \sqrt{N}) \sqrt{N/(N-1)}$$

Table III gives one striking evidence of the variability of values obtained from data in different publications. There is, however, rather good correspondence between the mean values obtained from ungraphed material and those derived from graphed material. On the whole the "experimental errors" appear to be of almost equal magnitude for all six teeth. If the standard errors of the means are studied, one finds relatively little variation between them from one tooth to another. That for the maxillary second incisor is an exception, being 0.11 years, or 39 to 41 days.

The relative numbers of boys and girls in the tabulations for mixed groups were approximately the same, insofar as could be determined. (For certain details of data by Bunting (5) one must consult Bean (1).) In view of this, it was possible to convert the median ages of eruption for such mixed groups into median ages for males and females. Those for girls were obtained by subtracting one half of each established sex difference from the appropriate median age for a mixed group. Those for boys were obtained by adding the halved differences to the original values. In this study the median age of eruption was held to correspond to the point where a given frequency curve crosses the 50 per cent line of the graph.

Establishment of standards for median ages of eruption.

The completion of the preliminary procedures discussed above enabled one to commence the computation of the average median ages of eruption in males and females. By noting the points where the smoothed frequency curves cross the 50 per cent lines of the graphs, the median ages of tooth

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emergence had been determined for each tooth in each sex for several groups of children. By eliminating the reports which did not contain an acceptable definition of "eruption," one could base the computations on the best available data. For example, all reports dealing exclusively with "fully erupted" teeth were disregarded. Only the reports listed in Table II were considered, as it was not felt wise to rely here on any statistical material which could not be evaluated *in toto* by an inspection of its graphic forms.

The final stages of this study had to be carried out on the assumption that the reports utilized for summarization were of equal mathematical worth. It was realized, of course, that this was not actually the case, despite the rigid selection of basic material. However, there was no way of evaluating the comparative biometric reliability of each separate item. All one could hope to accomplish was the establishment of averages which would be reasonably free of any serious distortions due to unavoidable "experimental (i.e., observational) errors." One would expect that since there would be a haphazard distribution of the more reliable and the less reliable basic age items along the time axis, the computed midpoint would represent the best possible compromise between them. The extreme values would cancel each other.

The results of these efforts to determine the most likely median ages of tooth emergence are brought together in Table IV. This table, like Table III, gives one a vivid picture of the surprising variability of figures obtained from different sources, although the data deal exclusively with Caucasians living in the northern temperate zone. Yet the standard errors of the averaged median ages show a remarkable degree of uniformity for all six teeth. Apparently there is almost no difference between the reliability of the available data on males and females, although those on males show slightly less variation than those on females. The median ages of tooth emergence are most securely established for the maxillary first incisor, with standard errors of only 0.04 and 0.05 years (i.e., ± 13 to 20 days). Some teeth, like the mandibular first incisor, have a standard error of 0.06 years (i.e., ± 21 to 23 days).

The median ages given in Tables IV and V represent correct values only for such eventually erupting tooth populations as correspond in number exactly or very closely to the child population samples examined. For five out of the six classes of permanent teeth discussed in this report the median age for a tooth population is the same as that for the child population. The maxillary second incisor is an exception to the rule, since about 2 per cent of the children never erupt the tooth. This means that 50 per cent of the teeth destined for eventual emergence will be present as soon as the tooth can be seen in the mouths of only 49 per cent of the children.

The last column of Table IV shows the average median ages after adjustments that make the sex differences correspond to those shown in the last column of Table III. In a few instances the averages computed from the items utilized for Table IV were one or two hundredths of a year more

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TABLE IV

Median ages of tooth emergence, computed to nearest hundredth of a year.

TOOTH		NUMBER OF MEDIAN AGE ITEMS AVERAGED	RANGE OF MEDIAN AGES	AVERAGED MEDIAN AGES WITH STANDARD ERRORS ¹	AVERAGED MEDIAN AGES ADJUSTED TO SHOW ESTABLISHED SEX DIFFERENCE
Max. M-1	♀	10	5.99 - 6.53	6.25 ± 0.06	6.25
	♂	11	6.17 - 6.68	6.43 ± 0.05	6.43
Mand. M-1	♀	10	5.74 - 6.29	5.98 ± 0.06	5.97
	♂	10	6.01 - 6.51	6.23 ± 0.06	6.24
Max. I-1	♀	12	6.92 - 7.48	7.13 ± 0.05	7.13
	♂	14	7.20 - 7.65	7.40 ± 0.04	7.40
Mand. I-1	♀	10	5.98 - 6.68	6.18 ± 0.06	6.17
	♂	11	6.16 - 6.96	6.44 ± 0.06	6.45
Max. I-2	♀	12	7.80 - 8.52	8.11 ² ± 0.06	8.11
	♂	13	8.37 - 9.00	8.58 ² ± 0.06	8.58
Mand. I-2	♀	12	6.99 - 7.55	7.23 ± 0.05	7.24
	♂	13	7.34 - 7.87	7.61 ± 0.05	7.60

$$^1SE_{mean} = \pm (S.D. / \sqrt{N}) \sqrt{N/(N-1)}$$

²The median ages for the tooth populations destined for eruption are 8.09 and 8.56 years, for males and females, respectively.

or less than those shown in Table III. The amount of source material utilized for the computations summarized in Table III was more than that used for constructing Table IV. Since the sex differences given in the former table can be looked upon as more reliable than those represented by the averages in the latter table, it was felt advisable to make the adjustments shown in the last column of Table IV before proceeding with the determination of the mean ages of tooth eruption.

Summarization of graphed data on variation in eruption.

The determination of the mean ages of tooth emergence presented one of the most difficult tasks of the study. To begin with, it could not be as-

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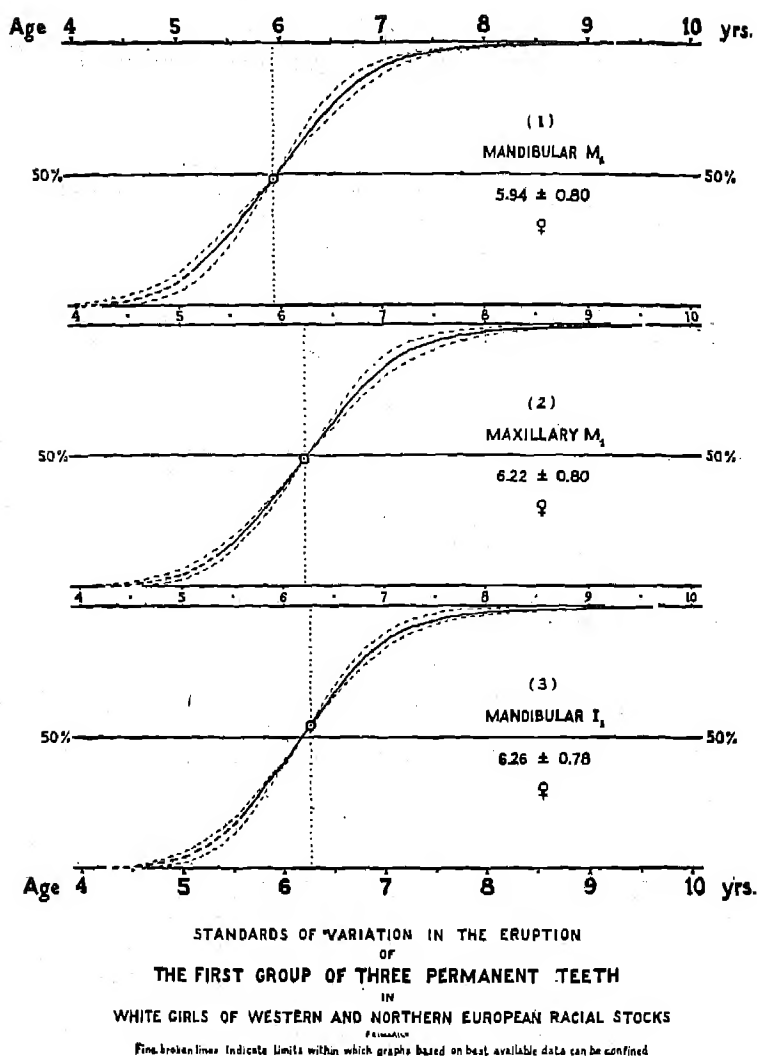


FIGURE 2

irregular or even discontinuous curves are obtained by averaging without selection the meager graphic data relating to the age period mentioned above.

In order to overcome the difficulties encountered in trying to plot the average cumulative frequency curves for early eruptors, recourse was had

to an indirect method of attack. It was known that all complete graphs for various classes of teeth showed a high degree of likeness between the two halves of a curve. The curves which represented actually recorded clinical data were very similar to symmetrical logistic curves obtained mathematically; in both cases the curvature in the first half of a given frequency diagram being comparable with the curvature in the second half of the same diagram. There was no reason whatever for believing that the three teeth referred to in the preceding paragraph had integral curves differing in character from those of the other permanent teeth. Therefore, it appeared feasible to determine the probable shapes of the lower sections of their standard curves by utilizing for summarization only such graphic material as appeared suitable for the purpose. The summarizing was limited to the few complete or nearly complete individual curves whose middle and upper sections resembled the corresponding sections of the curves obtained by averaging all available graphic data on the three teeth. Finally, in order to indicate that a certain amount of guesswork was necessary in determining the exact forms of these three curves, heavy broken lines were used in drawing the less securely established lower portions shown in Figures 1 and 2.

The third important point brought out by the summation of available graphic material was the consistent asymmetry of the curves. Although, as stated previously, the curves which result from a plotting of actual observational data are very similar to symmetrical logistic curves, this similarity is by no means as close as certain published analyses would lead one to believe. Furthermore, the degrees of asymmetry of the frequency distributions vary for the different classes of teeth. In the case of each of the six permanent teeth studied the proportion of curve above the 50 per cent line is noticeably more than that below the same level. Concomitantly the curvatures above the points of inflection are invariably less sharp than those below, as can be seen by studying Figures 1, 2, 3 and 4.

Another point brought out in the course of this comparative study concerns the remarkable degree of similarity between the shapes of individual graphic curves drawn for the same tooth. It is to be remembered that the individual curves represent data collected on widely-scattered white population groups in the northern temperate zone at different periods of time. The seventeen authors listed in Table I represent eight different countries. The eighteen reports produced by them appeared at irregular intervals between the years 1857 and 1940. Notwithstanding the wide divergence between the various sources of data, the individual curves for a given tooth vary rather little from each other in form.

This fact can be demonstrated visually by drawing for each tooth the limits of a zone which could contain the separate curves if these were superimposed so that their median age points (or points of inflection) coincided. The fine broken lines on each side of the curves shown in Figures 1, 2, 3

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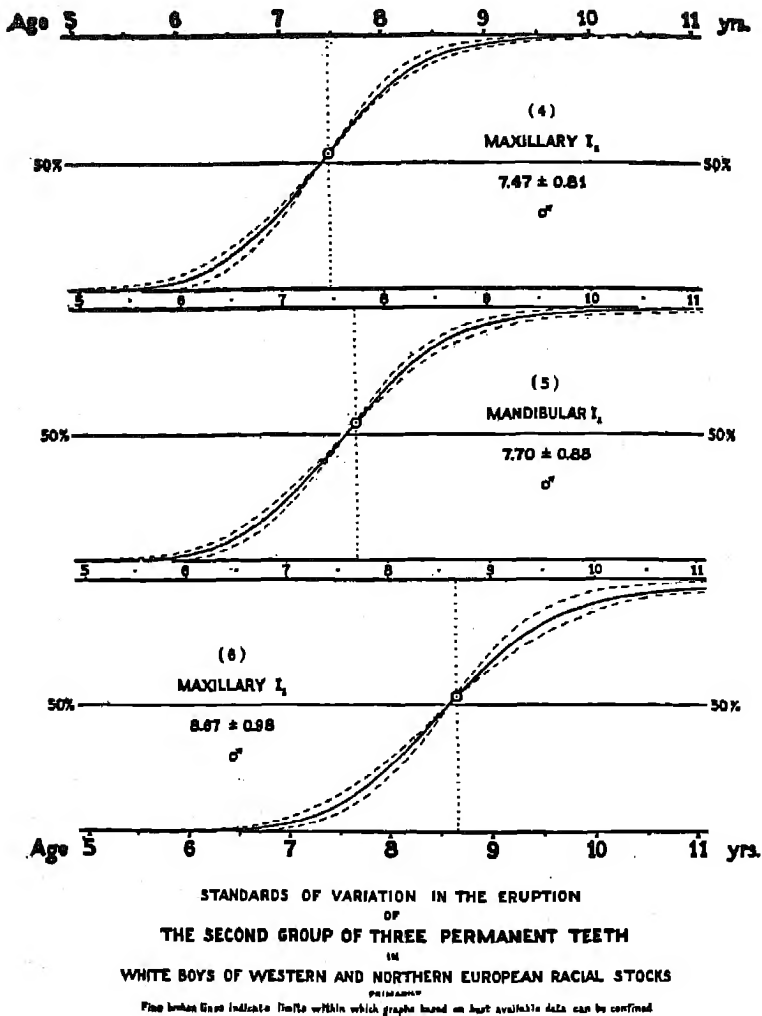


FIGURE 3

and 4 indicate such limits.¹ The zones shown in the diagrams are very narrow for some teeth, among which the mandibular first and second in-

¹The graphs representing Bunting's data on the three teeth shown in Figures 1 and 2 were omitted in drawing the zone limits. These graphs differed so markedly from the general pattern of all other graphs that they were suspected of representing statistically questionable observations.

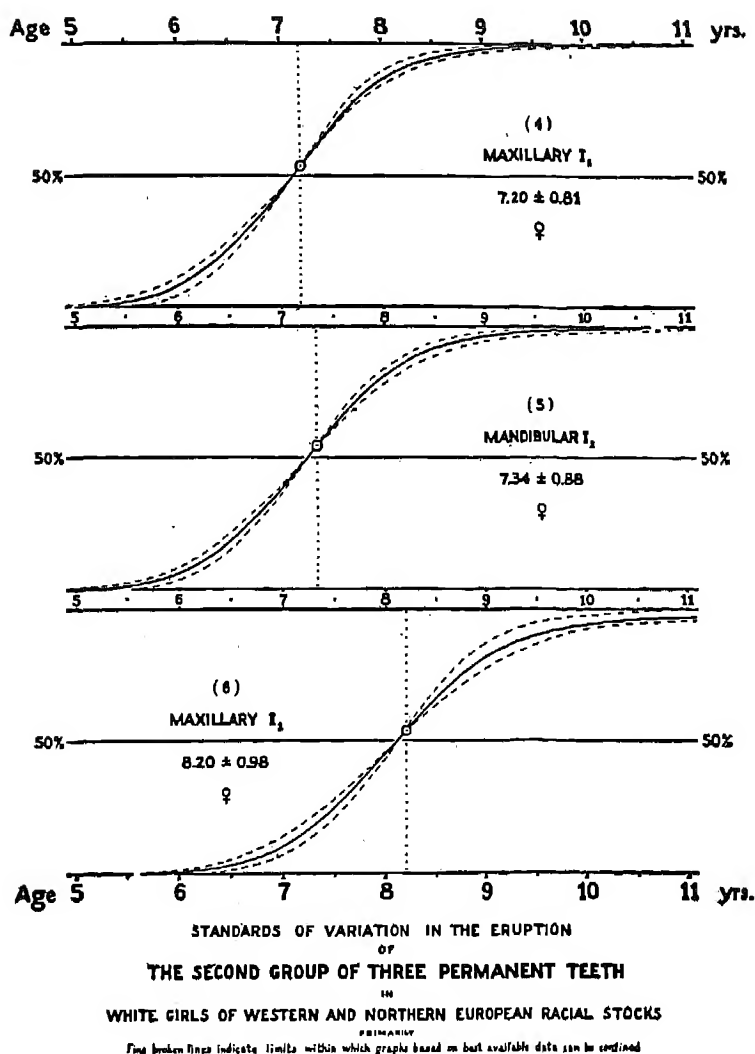


FIGURE 4

cisors are the most conspicuous. The greatest disagreement regarding the shape of the eruption curve centers around the maxillary second incisor.

The fifth interesting by-product of the curve summarization process has to do with the same tooth, to wit, the maxillary second incisor. Figures 3 and 4 do not show the cumulative frequency curve for this tooth reaching

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the 100 per cent line, as do all of the other standard curves. This failure is not due entirely to an insufficiency of space for drawing the diagram. The massed statistical evidence indicates beyond any doubt that there is fairly frequent agenesis and nonemergence of the organ in question. The curve that represents an averaging of 28 individual items levels off at, or slightly above, the 98 per cent line. Thus about 2 per cent of white children of western and northern European racial stocks fail to either develop or erupt the tooth.

TABLE V

*Median and mean ages of tooth emergence, with computed¹
standard deviations.*

(The values are expressed decimally, in terms of years.)

	TOOTH	MEDIAN AGES	MEAN AGES	STANDARD DEVIATIONS (for both sexes)
Max. M-1	♀	6.25	6.22 ²	0.80 ³
	♂	6.43	6.40 ²	
Mand. M-1	♀	5.97	5.94 ²	0.80 ³
	♂	6.24	6.21 ²	
Max. I-1	♀	7.13	7.20	0.81
	♂	7.40	7.47	
Mand. I-1	♀	6.17	6.26	0.78
	♂	6.45	6.54	
Max. I-2	♀	8.11 ⁴	8.20	0.98
	♂	8.58 ⁵	8.67	
Mand. I-2	♀	7.24	7.34	0.88
	♂	7.60	7.70	

¹Computation is specified to indicate that the standard deviations were not derived by using probability paper, or other indirect methods.

²Probably somewhat too low.

³Probably one or two hundredths of a year too high.

⁴Median age for tooth population destined for eventual emergence is 8.09 years.

⁵Median age for tooth population is 8.56 years.

Establishment of standards for mean ages of eruption.

The completion of the tasks described above made it possible, finally, to calculate the mean ages and standard deviations of tooth emergence. The system of procedure developed by Broca was used. The numerical data needed were obtained from large-scale diagrams showing the standard curves for each tooth. The age classes employed were on the basis of tenths of a year; the hypothetical number of individuals considered was 1,000 in all cases except one. The exception concerned the maxillary second incisor, for which tooth the hypothetical number employed was 980.²

The means and their standard deviations are given in the diagrams (Figures 1, 2, 3 and 4) and in Table V, which brings these data together with the median ages already computed. The mean ages of eruption are seen to be generally higher than the median ages. In the case of two teeth the difference is as much as one tenth of a year. As was mentioned earlier, Chérot found similar differences between mean and "probable" ages.

The first molar figures on means and medians form an exception to the general rule. The mean ages of eruption for these teeth are 0.03 of a year lower than the median ages. It is quite likely that this exceptional sequence is due to the insufficient quantity of reliable data that could be obtained for determining the exact shapes of the lower parts of the cumulative frequency curves for these teeth. Future investigations may show that these curves should be somewhat steeper than the ones shown in Figures 1 and 2. In that case the mean age points would shift slightly to the right (perhaps even above the 50 per cent line), while the standard deviations would come out less than 0.80 of a year.

SUMMARY

1. Lack of summarized data on the eruption of permanent teeth has forced anthropologists and students of child development to contend with a number of disharmonious tabulations. The degrees of agreement and disagreement between various publications have been unknown.

2. This report furnishes a synthesis of the best available data on the emergence of the first six permanent teeth in boys and girls living in the northern temperate zone. The material analyzed and summarized represents western and northern European ethnic groups almost exclusively.

²Due to the fact that a few individuals in any large population group fail to develop one or more of their permanent teeth, no frequency curve should actually reach the 100 per cent level. With the exception of the maxillary second incisor tooth the percentages of agenesis and nonemergence are so small for the other five classes of teeth discussed in this paper that no serious errors result from ignoring them.

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NEWS NOTES

A clearinghouse for research in child life.

A clearinghouse for research in child life has recently been established in the Children's Bureau, of the Social Security Administration, Federal Security Agency, as an aid to research workers in keeping abreast with studies in progress. Lack of a place where investigators could find out about current projects in their own fields, or related ones, has been a handicap to many in the past. The clearinghouse will provide a systematic way to keep professional people informed about research in progress, and to bridge the time-gap between completion and publication of work.

The establishment of a clearinghouse in the Children's Bureau grew out of a series of conferences held during the past year to review what is going on in research in child life, what the gaps are, and how the needs for research can be met. Representatives of many fields in child life research participated in one or more of these conferences.

The clearinghouse will canvass investigators in various fields for reports of studies in progress, including collections of unpublished data. A bulletin will be released in 1949 containing information about current research in child life.

Information will be provided to research workers on request, but the Children's Bureau emphasizes that the clearinghouse will not attempt to summarize or indicate the conclusions of research projects, but will furnish accounts of the nature of projects as reported to it by individuals or organizations. Participation will be voluntary, but it is hoped that cooperation will be extensive, as the value of the clearinghouse will be dependent upon its scope and coverage.

Inquiries may be directed to Dr. Clara E. Councell, Director, Clearinghouse, Children's Bureau, Federal Security Agency, Washington 25, D.C.

Nation-wide survey of child posture.

The Federal National Fitness Council of Australia is sponsoring a nation-wide survey in Australia to determine the incidence of postural defects in school children, and to discover age trends. This survey was undertaken in response to requests made by the supervisors in physical education from the six states and from representatives of the School Medical Services.

Dr. Edith Clement, an officer of the New South Wales School Medical Service, was appointed to take charge of the work, together with a non-medical research officer. All of the states have been visited, and to date 30,000 children have been examined. Two-day instructional courses for the Physical Education Staff were conducted in each state. A series of photographs of children at ages 7, 10, and 13, showing certain defects and degrees of defects were used in the lectures to such staff. Children of different

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type builds were selected for the pictures and examiners were taught to look at the position of the head and shoulders, the thoracic and lumbar spine seen in a lateral view, knock knee, overcarriage, and total posture, and to identify deviations from the normal in these positions.

The study has been especially interested in adolescent kyphosis. An incidence of $3\frac{1}{2}$ per cent kyphosis has been found so far, and it is hoped that by the end of the investigation some conclusions will be reached regarding its cause and remedy.

The results are still being tabulated so that findings of the survey have not yet been reported, but it is the hope of those conducting the study, that remedial exercises for different age groups can be evolved as a result of the findings.

Inventory of research in race relations.

The Committee on Education, Training and Research in Race Relations of the University of Chicago, in cooperation with the American Council on Race Relations, is conducting an inventory of research in race relations and minority group problems, in order to make available information on current research which will be of value to persons and agencies carrying on research and also to those engaged in action programs in the field. It is planned to issue quarterly bulletins describing current and recently completed research projects. The inventory bulletins carry accounts of two kinds: (1) descriptions of studies reported in answer to the inventory questionnaire and (2) abstracts of studies contained in published articles, pamphlets and books. All those who are engaged in research in racial and cultural relations are invited to write to the Committee for the inventory questionnaire. The address is Committee on Education, Training and Research in Race Relations, The University of Chicago, 4901 Ellis Avenue, Chicago 15, Illinois.

Cross-disciplinary introductory course.

The Carnegie Corporation of New York recently announced that it had made a grant of \$13,500 to Northwestern University to assist in the development of a joint introductory course, to be entitled "An introduction to the sciences of human behavior," covering the fields of anthropology, psychology and sociology. The aim of the course is to coordinate the essential concepts and materials normally presented in the separate introductory courses of the respective fields.

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